

A vibrant red and black bird, likely a New Holland Honeyeater, is perched on a pine branch. The bird is facing left, with its head tilted down as it feeds on a bright red flower. The pine needles are dark green and sharp, contrasting with the bird's bright colors. The background is a soft, out-of-focus green, suggesting a natural, forest-like environment.

BIODIVERSITY SURVEYS, 2017

PREPARED FOR CITY OF RYDE
BY APPLIED ECOLOGY P/L



INTRODUCTION

Presented by Anne Carey and Dr Meredith
Brainwood, Applied Ecology P/L

OVERVIEW OF PRESENTATION

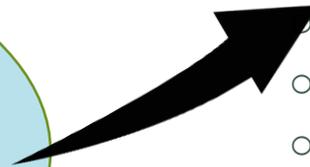
- Project background and context

- Survey methods
- Survey results
- Comparison with previous survey (Biosphere, 2007)

- Where to from here...

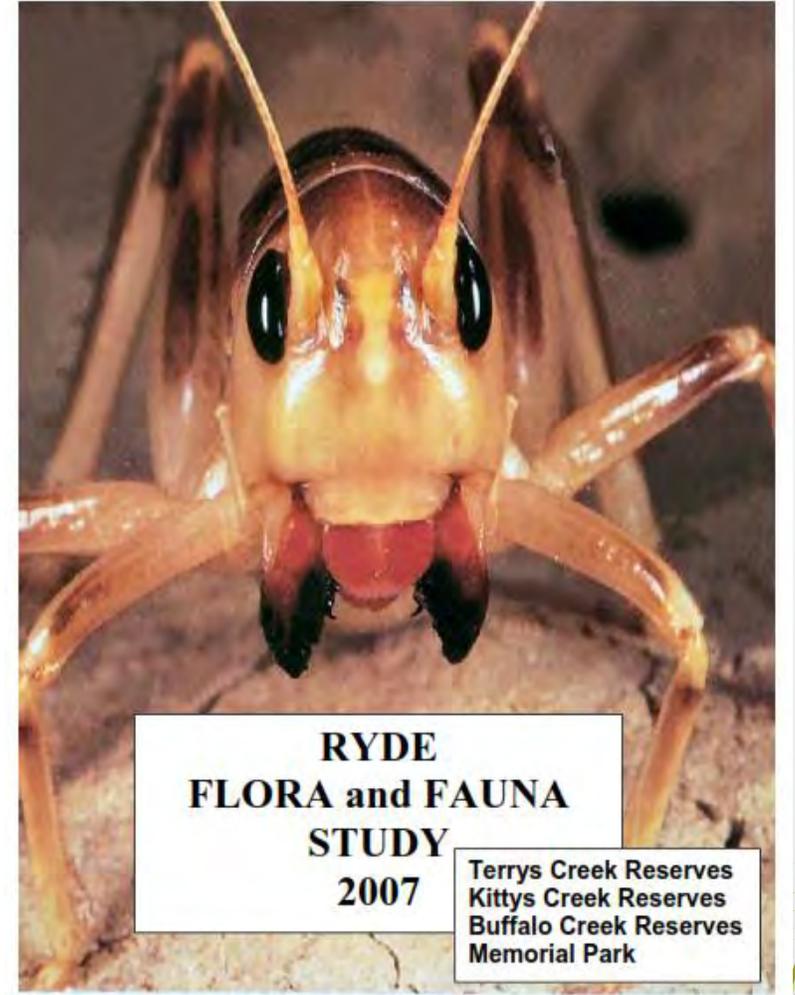
- BIODIVERSITY GROUPS:

- Native flora
- Introduced flora
- Vegetation communities
- Mammals
- Herpetofauna (reptiles & frogs)
- Avian fauna
- Microbats
- Invertebrates



PROJECT BACKGROUND

- Part of a series of flora and fauna studies for City of Ryde LGA
- Main aims are “standardised baseline information” about biodiversity of reserves
- Includes vertebrate and invertebrate fauna, endemic and introduced flora
- Stage 2 (2007) focused on [additional] water catchments in the LGA
- Information about species richness and abundance will inform management decisions for the reserves...



PROJECT CONTEXT

- **BIOSPHERE 2006**
 - Brush Farm Park, Darvall Park, Lambert Park, Field of Mars Reserve
- **BIOSPHERE 2007**
 - Terrys Creek reserves, Kittys Creek reserves, Buffalo Creek reserves, Memorial Park
- **BIOSPHERE 2008**
 - Other bushland reserves
- **ANNE CLEMENTS & ASSOC 2016**
 - Brush Farm Park, Darvall Park, Lambert Park, Field of Mars Reserve
- **APPLIED ECOLOGY 2017**
 - Terrys Creek reserves, Kittys Creek reserves, Buffalo Creek reserves, Field of Mars additional quadrats





APPLIED ECOLOGY 2017

- Quadrat surveys (20m x 20m):
 - Timed searches for mammals, herps and invertebrates (2 per season, autumn and spring)
 - Detailed flora surveys including % cover classes (Braun-Blanquet)
- General surveys for reserves to develop species richness inventories



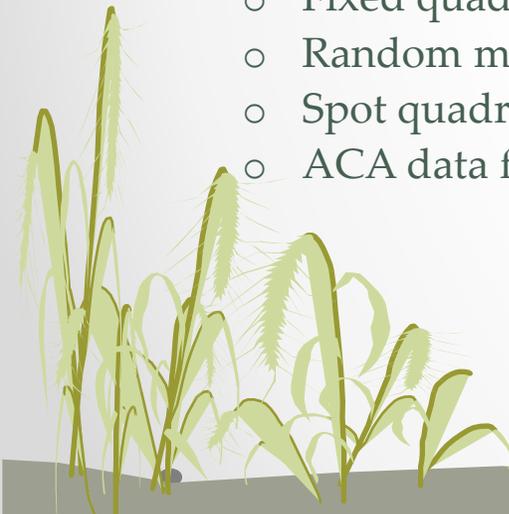
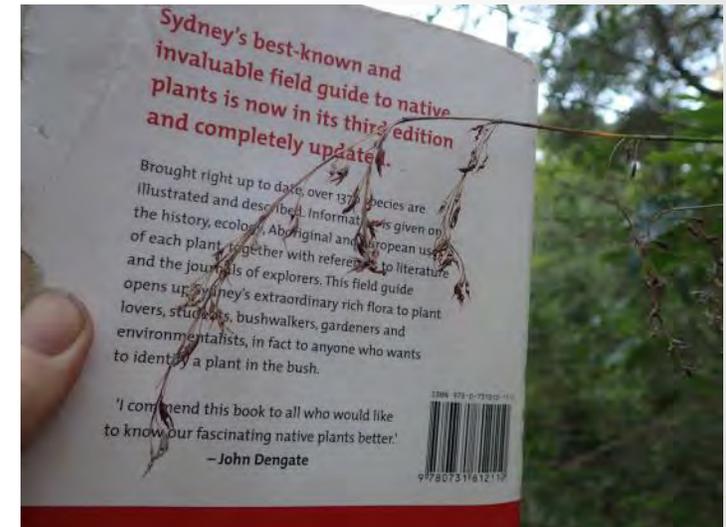
A photograph of a dense forest with a dirt path leading through tall trees and green undergrowth. The trees have thin, light-colored trunks and are covered in green foliage. The path is made of dirt and leads into the distance. The overall scene is a lush, natural environment.

Flora & Vegetation

Buffalo, Kittys, Terrys Creeks & Field of Mars Reserve

Overview

- Summary of floristic diversity (for reserves and corridors)
- Changes over time (based on fixed quadrat surveys 2007-2017)
- Targeted threatened species surveys
- Ground truthing of vegetation mapping, based on
 - Fixed quadrats
 - Random meanders
 - Spot quadrats
 - ACA data from 2016



Methodology

- Needed to replicate the methods developed in 2006 by Biosphere
- Used in our target reserves in 2007
- Comprised:
 - General survey of plant species in each reserve
 - Quadrat based surveys at established locations using 7 stage Braun-Blanquet cover classes
 - Ground truthing of vegetation mapping developed by OEH in 2013

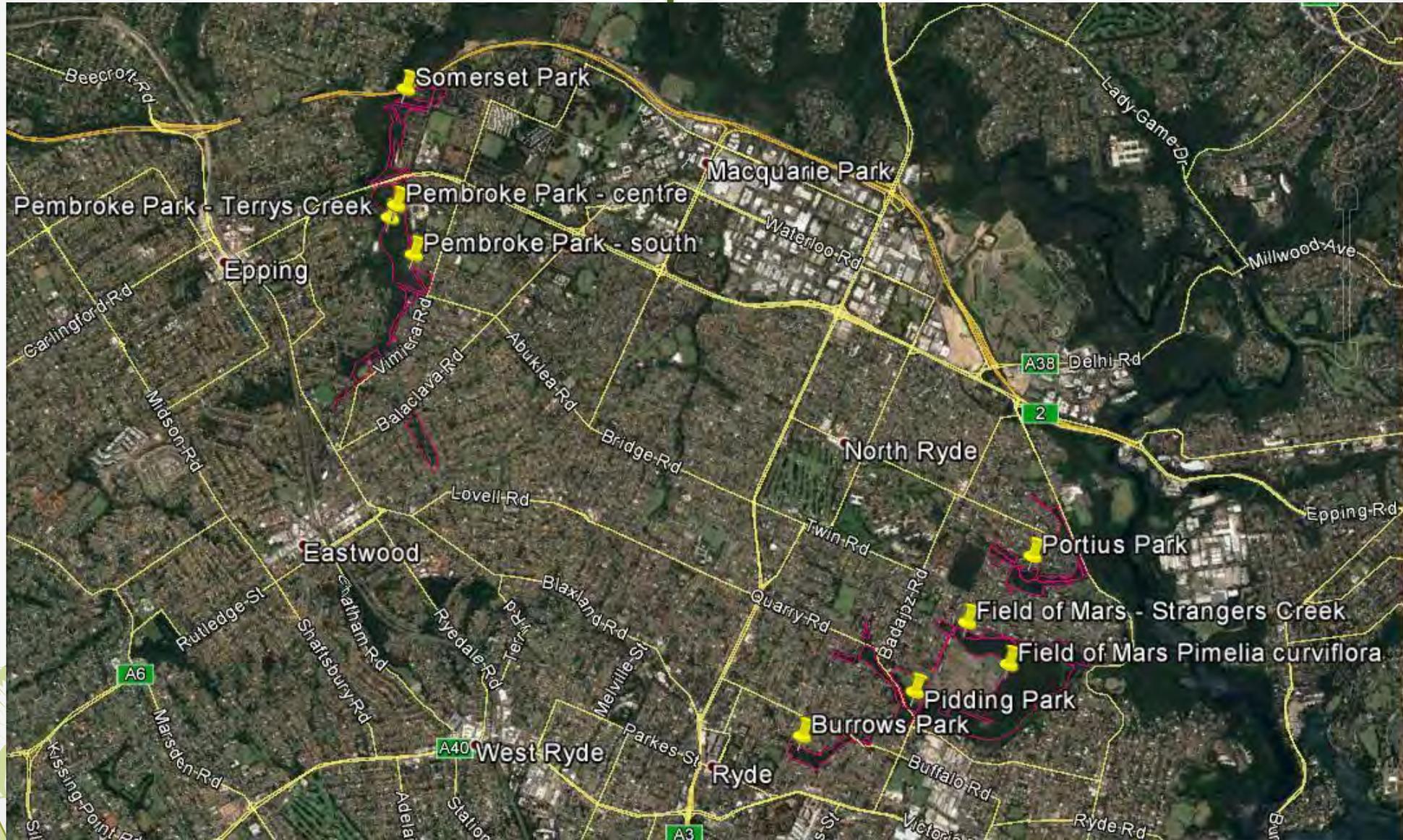


Location of quadrats

- *“Each survey site consisted of a 20m by 20m square i.e. 400 square metres quadrat. Survey pegs and string lines were used to mark the boundaries of each quadrat and the location of each corner peg was plotted by GPS (in case they were interfered with or removed).”*
- *(Biosphere, 2007)*

Catchment	Park or Reserve	Quadrat Name	Vegetation Community Represented	Area (m ²)
Terrys Creek	Pembroke	'Pembroke'	Disturbed Western Sandstone Gully Forest*	400
	Pembroke	'Acacia binervia'	Disturbed Western Sandstone Gully Forest*	400
	Pembroke	'Coachwood / Xmas Bush'	Disturbed Sandstone Ridgetop Woodland*	400
	Somerset	'Somerset'	Sandstone Ridgetop Woodland	400
Kittys Creek	Portius	Wolfe Road	Western Sandstone Gully Forest	400
Buffalo Creek	Pidding	'Pidding'	Sydney Turpentine-Ironbark Forest And Western Sandstone Gully Forest	400
	Burrows	'Burrows'	Sydney Turpentine-Ironbark Forest	400
Strangers Creek	Field of Mars	'Strangers Creek'	Most likely Shale / Sandstone Transition Forest (high sandstone influence)	400
		'Pimelia curviflora'	Turpentine Ironbark Margin Forest	400

Reserves and quadrat locations



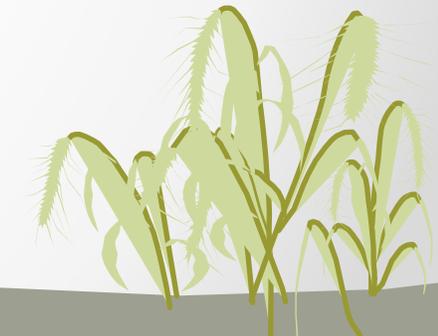
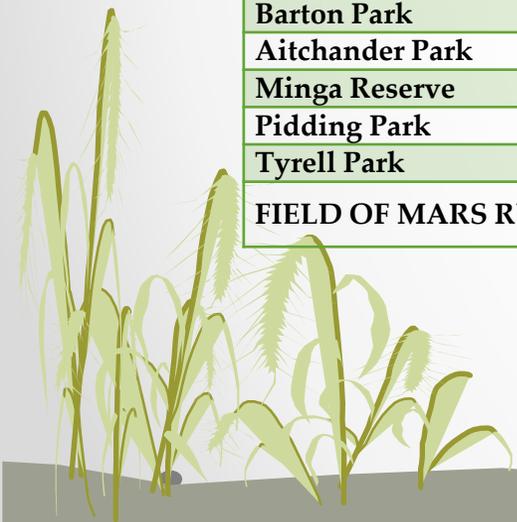
Braun-Blanquet cover classes

Cover Class	Biosphere (2006)		Interpreted in 2016 as
1	<i>Rare</i>	<i>few individuals (three or less) and cover <5%</i>	≤ 3 individuals AND <5% cover
2	<i>Uncommon</i>	<i>more than three but not consistently throughout the plot and cover <5%</i>	>3 individuals AND cover <5%
3	<i>Common</i>	<i>consistent throughout the plot and cover <5%</i>	cover <5% throughout the quadrat
4		<i>Very abundant cover <5% OR cover >5% but <20%</i>	6–19% cover in quadrat
5		<i>Cover >20% but <50%</i>	21% – 49% cover in quadrat
6		<i>Cover >50% but <75%</i>	51% – 74% cover in quadrat
7		<i>Cover >75% but <100%</i>	76% – 99% cover in quadrat

Assigns the abundance for each species to a ranked grouping, and this can be used to determine whether observed changes in cover should be considered significant.

2017 SURVEY RESULTS	# NATIVE SP	# INTRODUCED
TERRYS CREEK CORRIDOR	(253 sp)	(141 sp)
Jim Walsh Park	34	52
Yarramar Reserve	5	not recorded
Forsyth Park	85	58
Forrester Park	54	63
Pembroke Park	174	74
Lucknow/Somerset Parks	178	50
Ivanhoe Park	79	49
KITTYS CREEK CORRIDOR	(181 sp)	(67 sp)
Pryor Park	78	27
Portius Park	93	40
Kittys Creek Reserve	61	17
Martin Reserve	68	30
BUFFALO CREEK CORRIDOR	(187 sp)	(132 sp)
Burrows Park	115	64
Laurel Park	42	51
Barton Park	67	66
Aitchander Park	50	56
Minga Reserve	50	44
Pidding Park	118	57
Tyrell Park	20	not recorded
FIELD OF MARS RESERVE	(298 sp)	(81 sp)

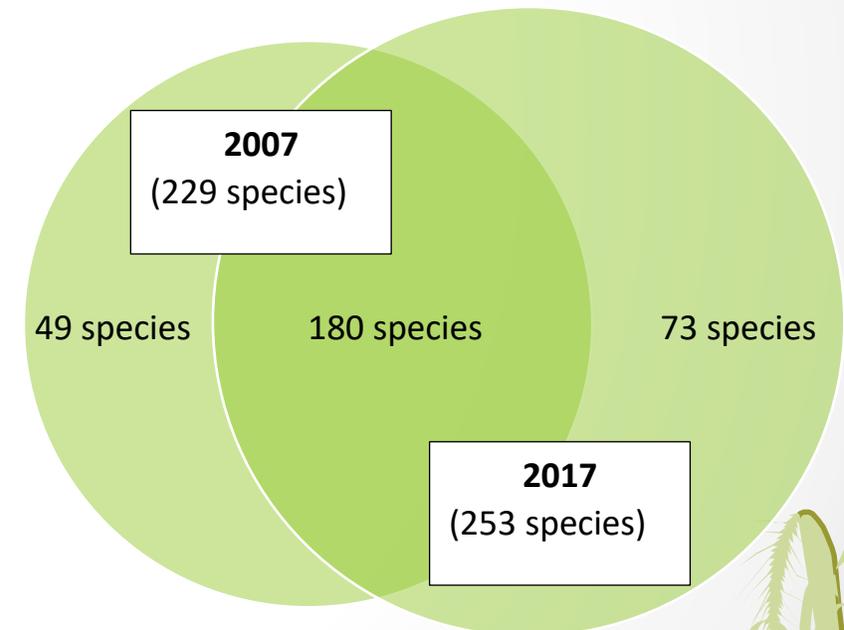
Summary of flora surveys



Terrys Creek Corridor

Number of species of native flora

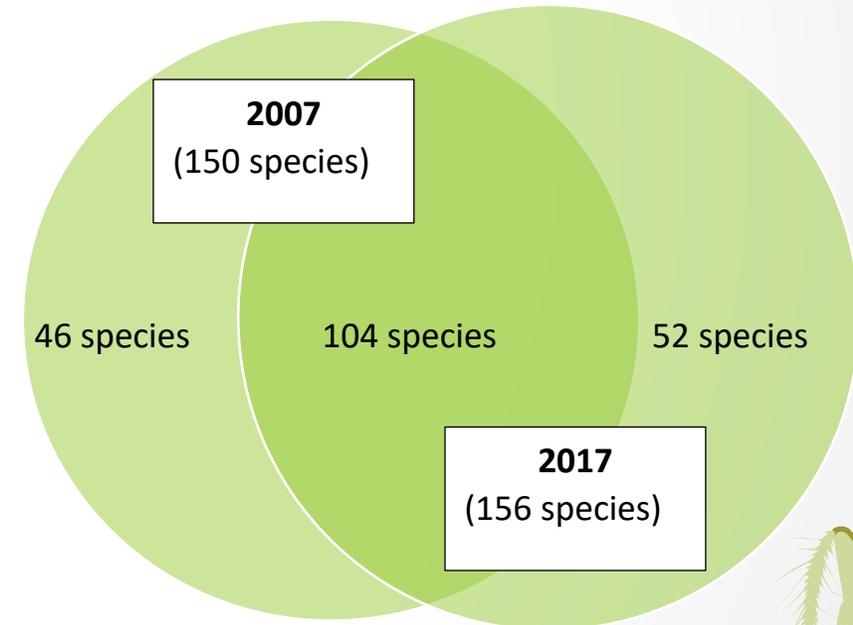
TERRYS CREEK	2007	2017	TOTAL RECORDED	IN BOTH SURVEYS	IN 2007 ONLY	IN 2017 ONLY
Forsyth/Forrester Reserves	60	108	125	43	17 (-13%)	65 (+52%)
Pembroke Park	153	174	215	112	41 (-19%)	62 (+29%)
Somerset/Lucknow Parks	185	178	228	135	50 (-22%)	43 (+19%)
Ivanhoe Reserve	45	79	96	28	17 (-18%)	51 (+53%)
TERRYS CREEK CORRIDOR	229	253	302	180	49 (-16%)	73 (+24%)



Kittys Creek Corridor

Number of species of native flora

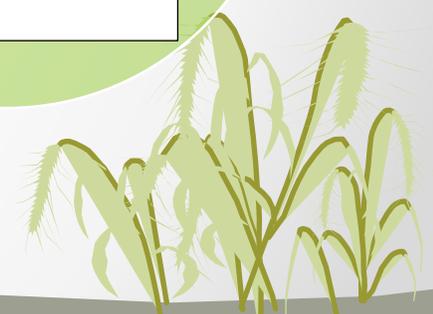
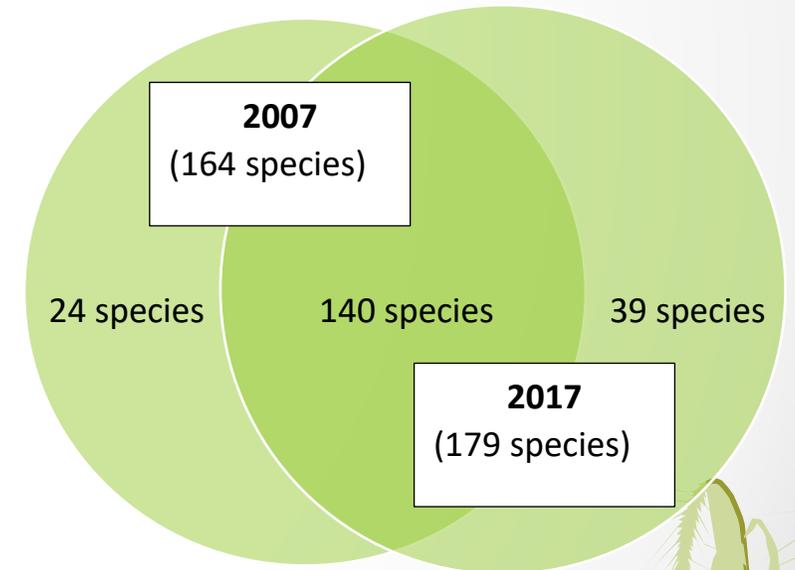
KITTYS CREEK	2007	2017	TOTAL RECORDED	IN BOTH SURVEYS	IN 2007 ONLY	IN 2017 ONLY
Pryor Park	60	78	106	32	28 (-26%)	46 (+43%)
Portius Park/Kittys Creek Reserve	105	119	148	76	29 (-20%)	43 (+29%)
Martin Reserve	74	68	97	45	29 (-30%)	23 (+24%)
KITTYS CREEK CORRIDOR	150	156	202	104	46 (-23%)	52 (+26%)



Buffalo Creek Corridor

Number of species of native flora

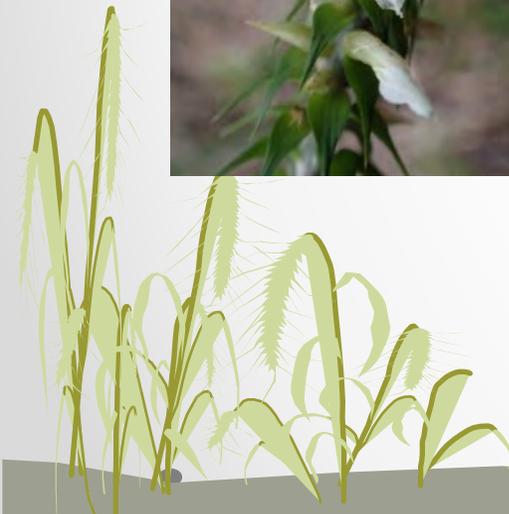
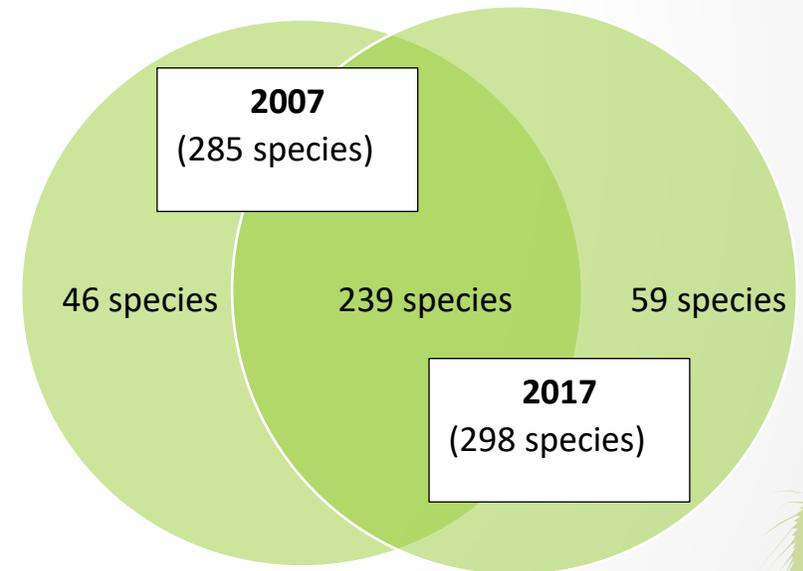
BUFFALOS CREEK	2007	2017	TOTAL RECORDED	IN BOTH SURVEYS	IN 2007 ONLY	IN 2017 ONLY
Burrows Park	84	115	130	69	15 (-12%)	46 (+35%)
Minga Reserve	42	50	68	24	18 (-27%)	26 (+38%)
Barton Park	98	67	119	46	52 (-44%)	21 (+18%)
Pidding Park	91	108	130	68	22 (-17%)	40 (+31%)
BUFFALOS CREEK CORRIDOR	164	179	203	140	24 (-12%)	39 (+19%)



Field of Mars Reserve

	2007	2017	TOTAL RECORDED	IN BOTH SURVEYS	IN 2007 ONLY	IN 2017 ONLY
FIELD OF MARS RESERVE	285	298	344	239	46 (-13%)	59 (+17%)

Number of species of native flora

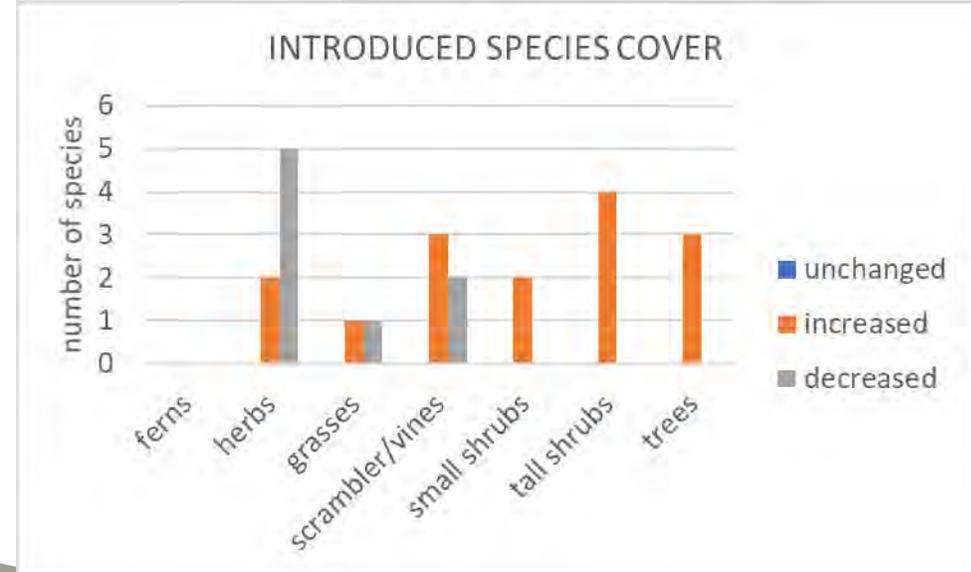
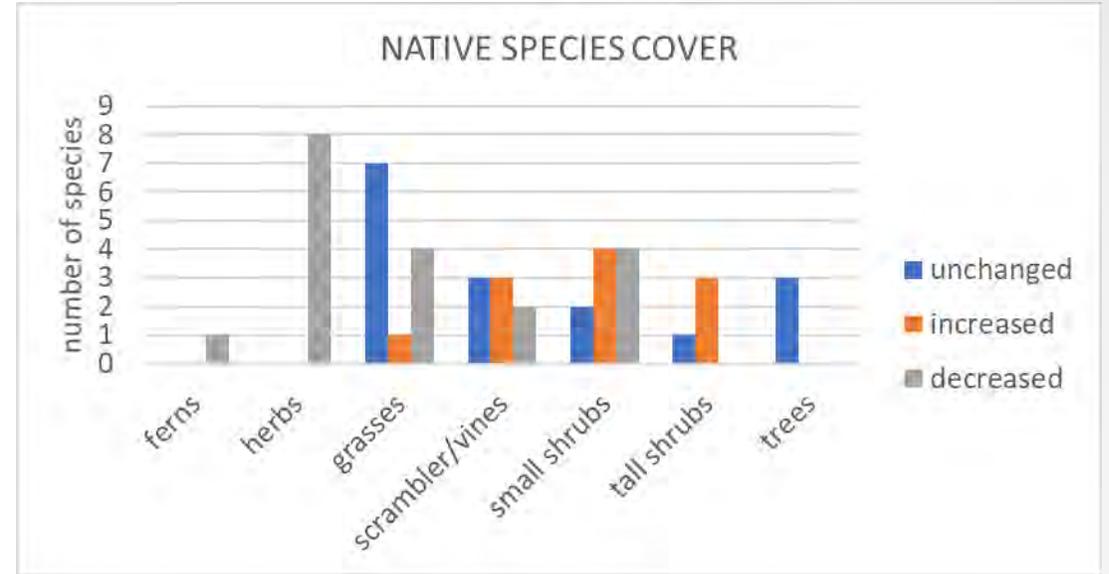
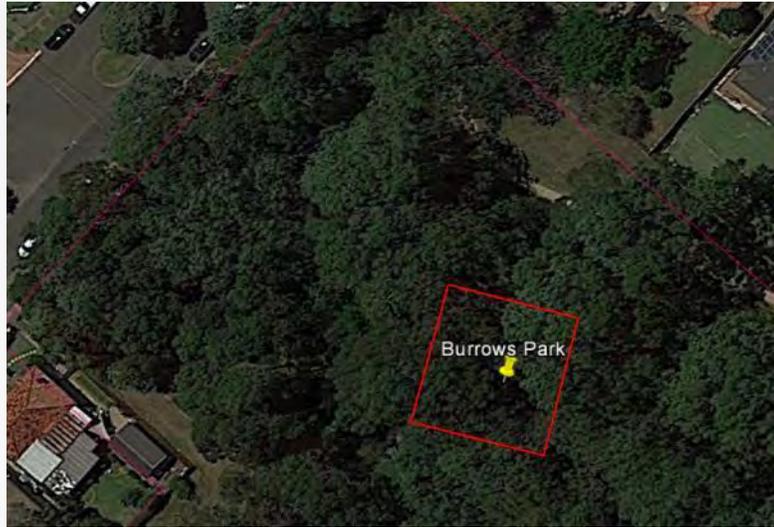


Fixed quadrat survey data

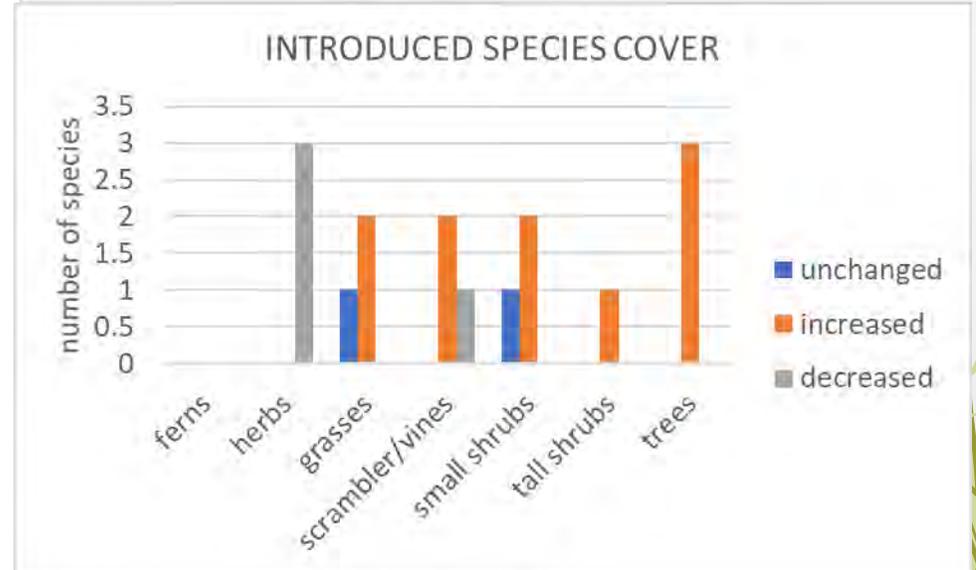
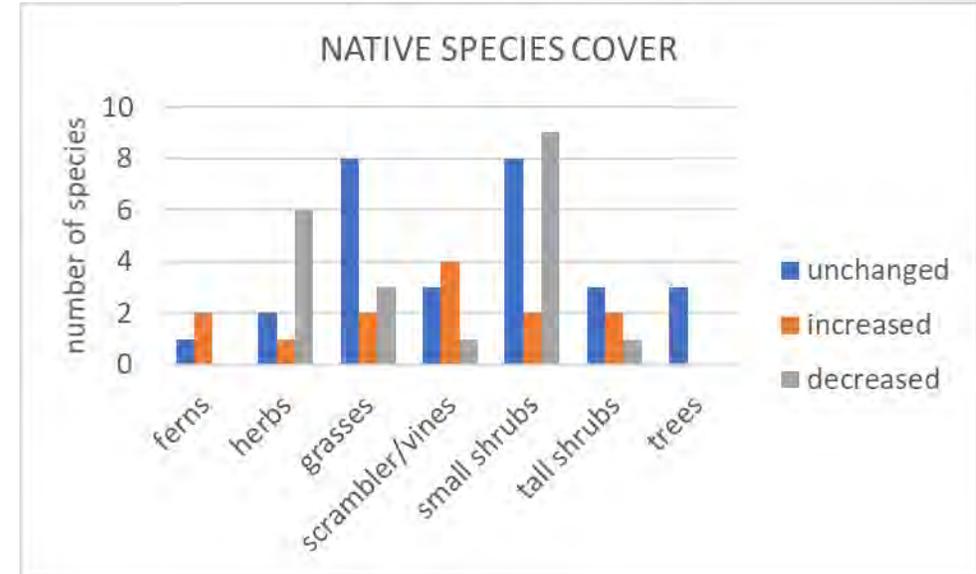
- First, estimate Braun-Blanquet cover classes for 2017
- Next, for each species, compare with previous cover class recorded in 2007 for that species in that quadrat, and determine if there is:
 - Increased cover
 - Decreased cover
 - Cover unchanged
- Finally, tally how many increased/decreased/unchanged for each floristic group (and for native and introduced species)



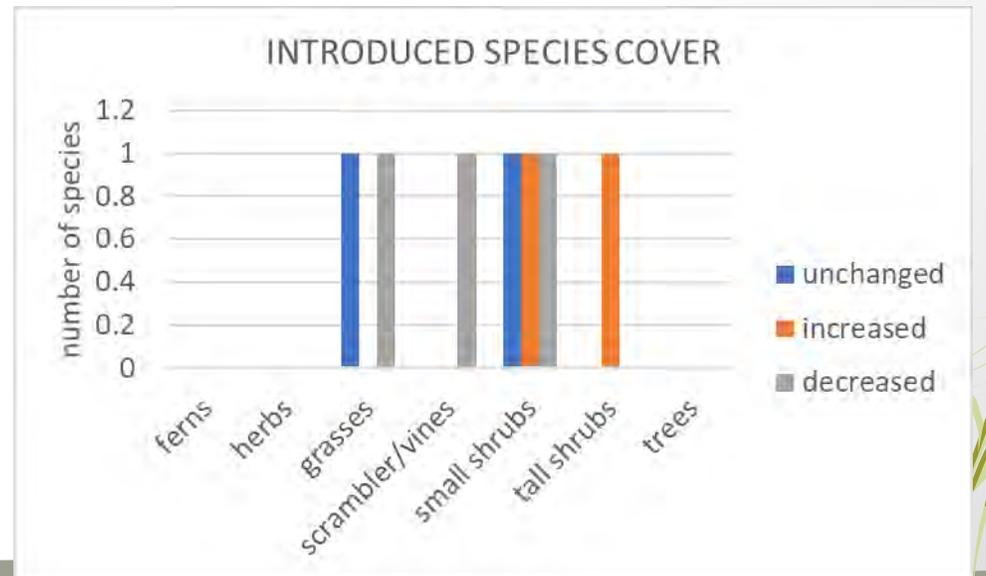
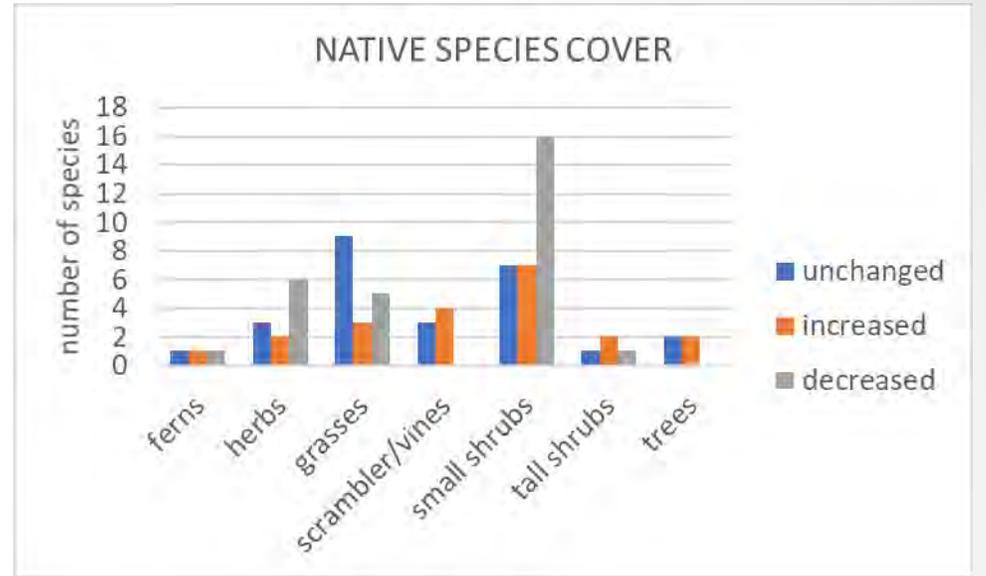
Burrows quadrat (BC)



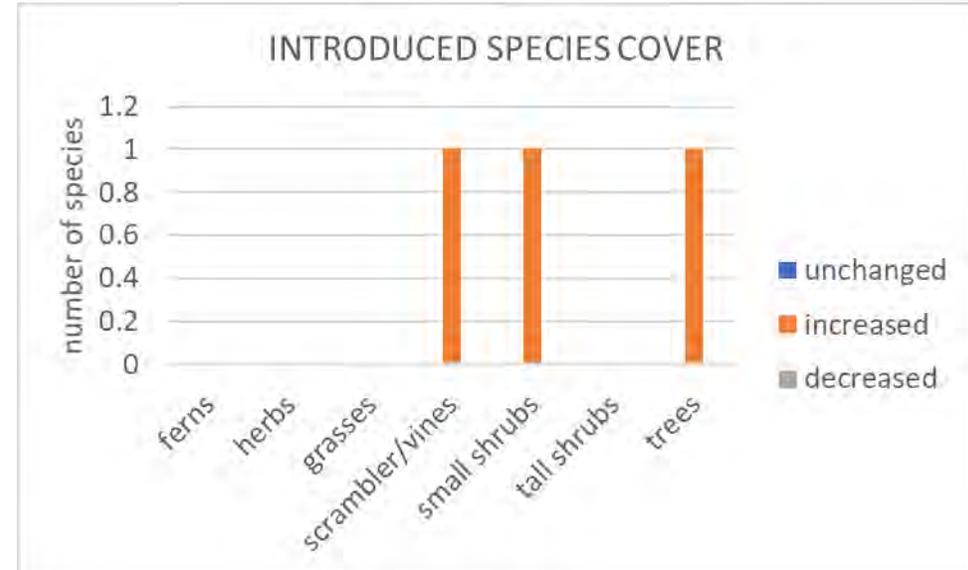
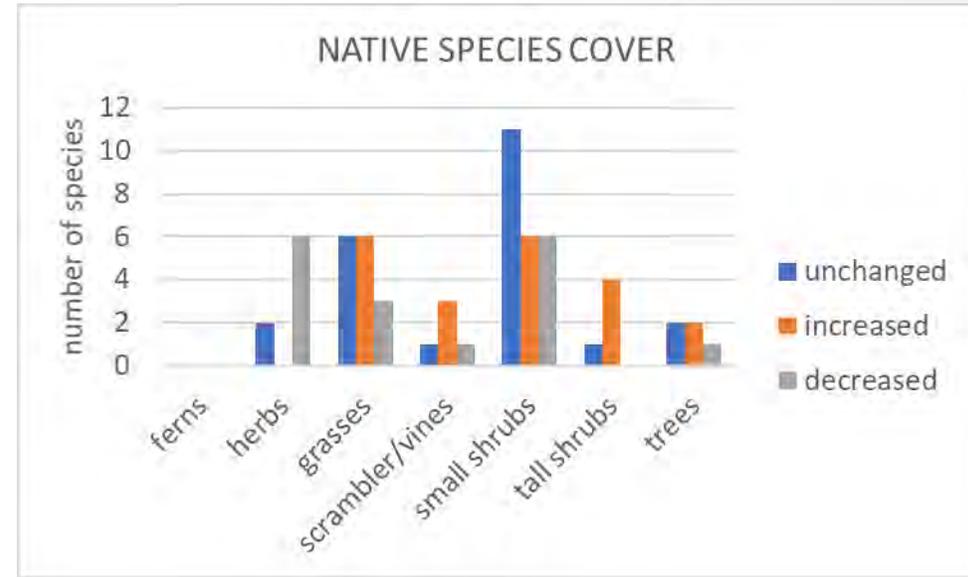
Pidding quadrat (BC)



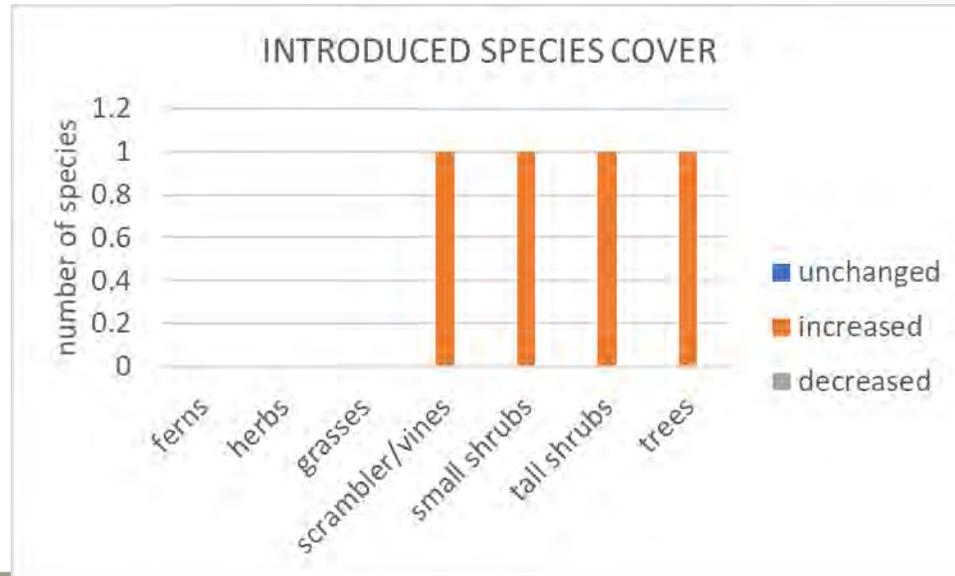
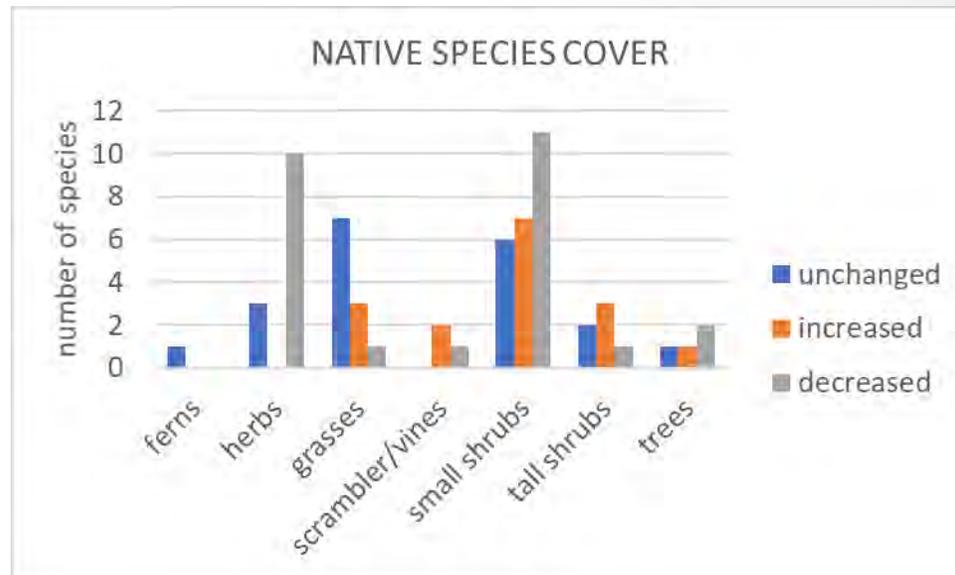
Strangers quadrat (FOM)



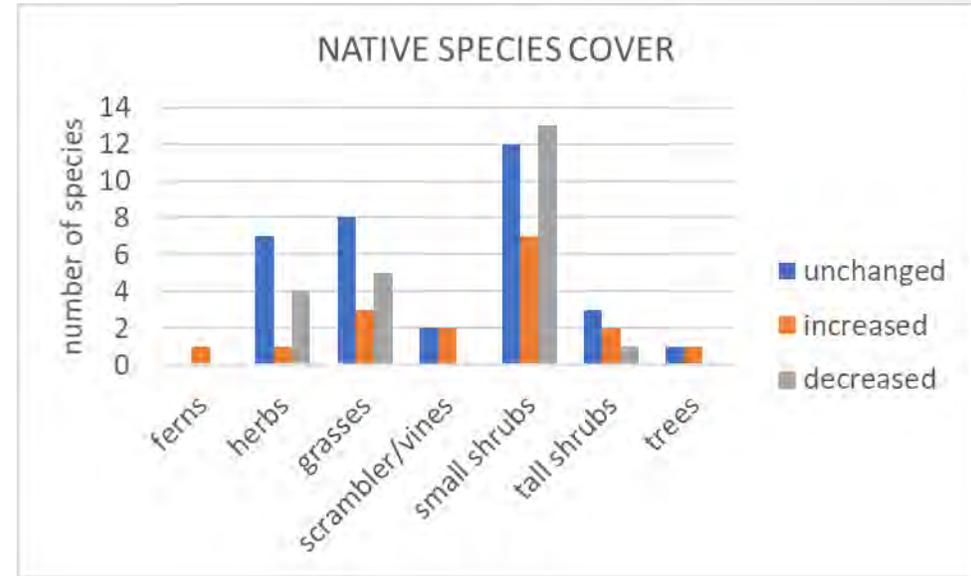
Pimelea quadrat (FOM)



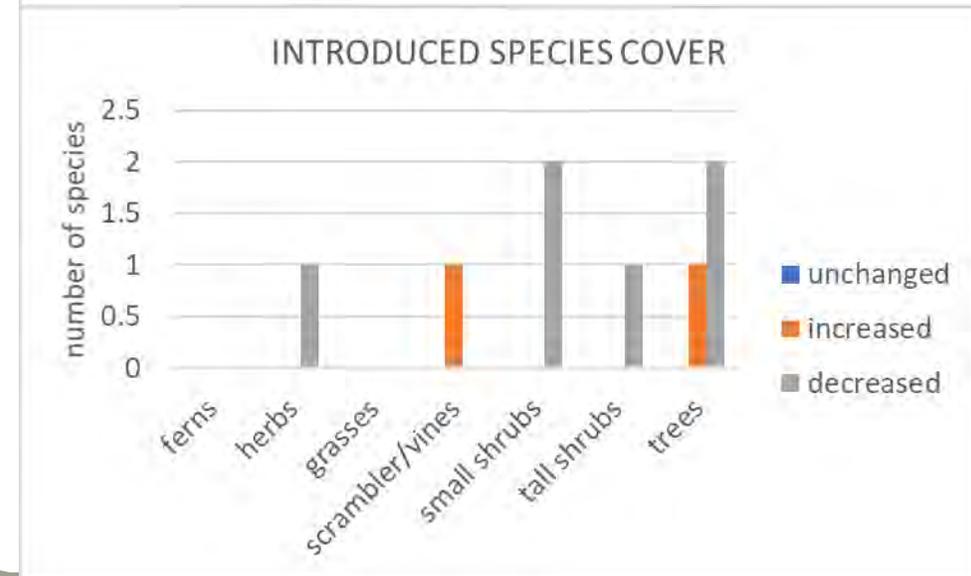
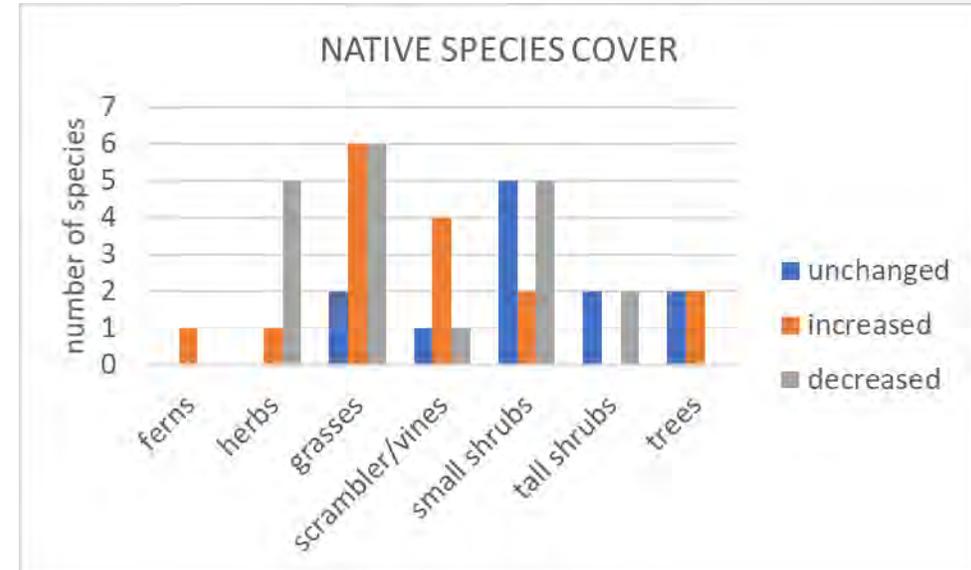
Wolfe Rd quadrat (KC)



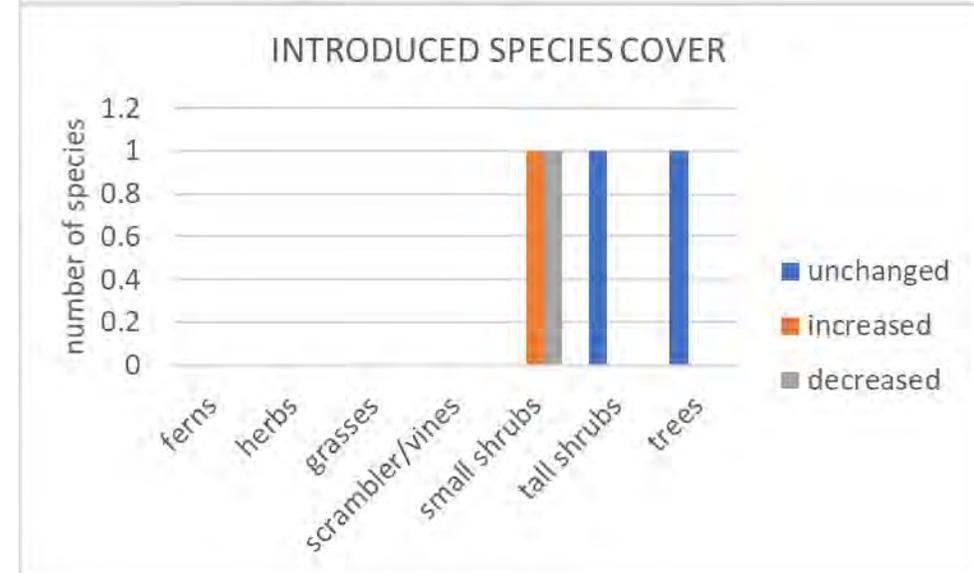
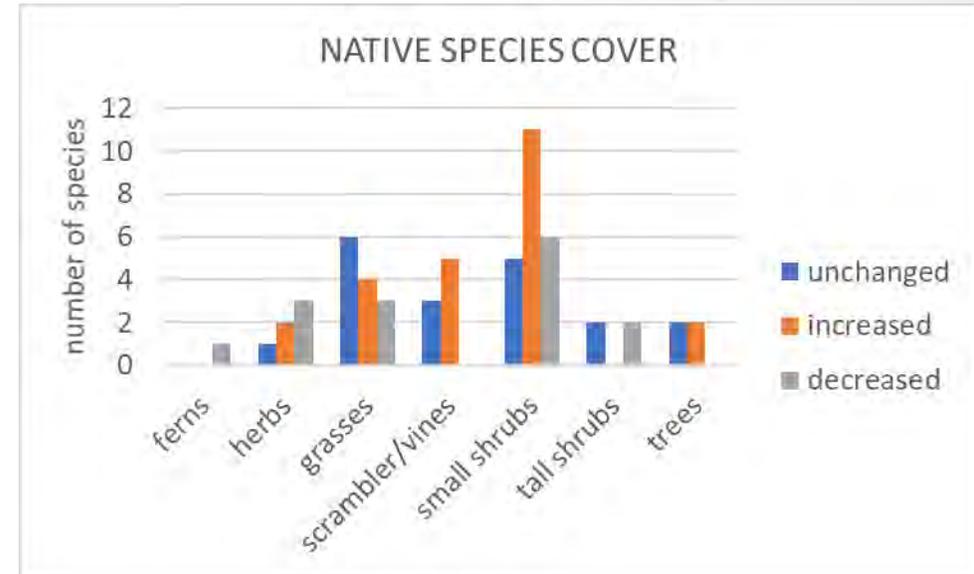
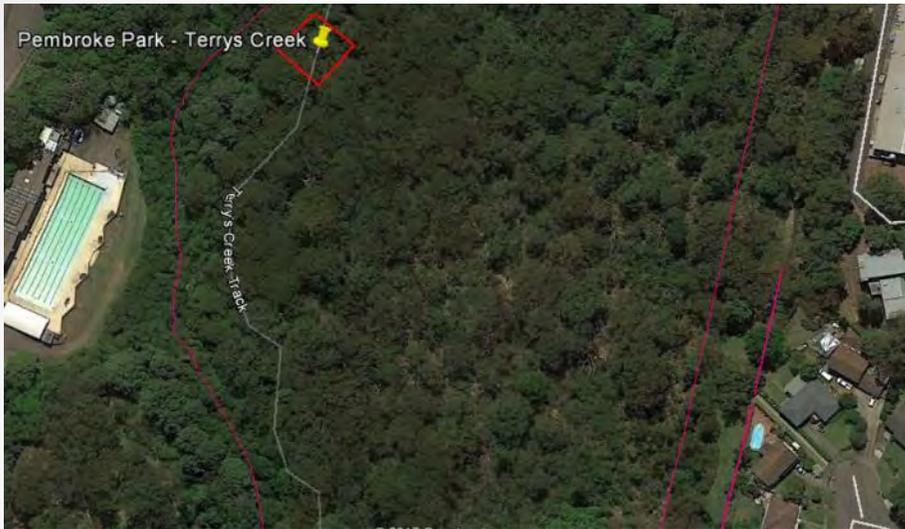
Lucknow quadrat (TC)



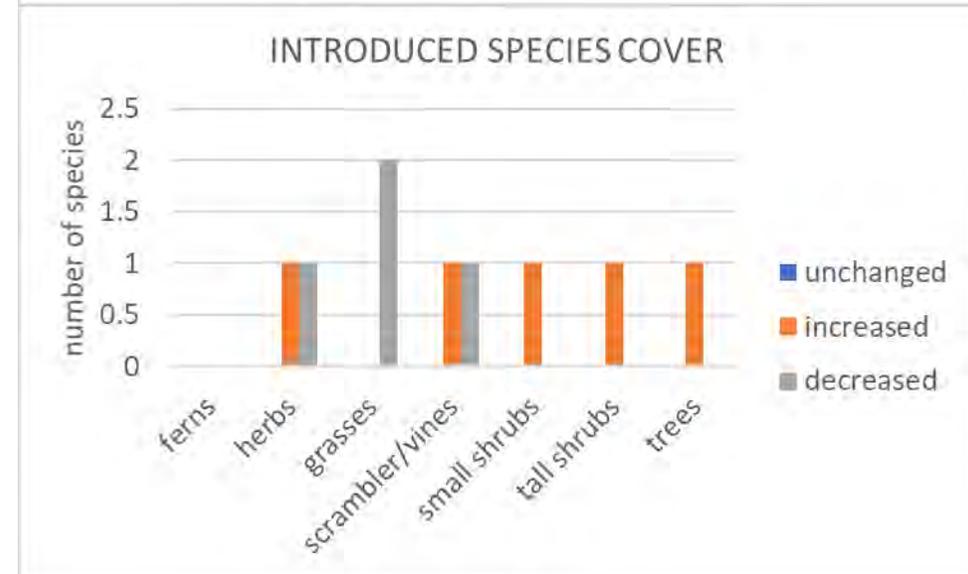
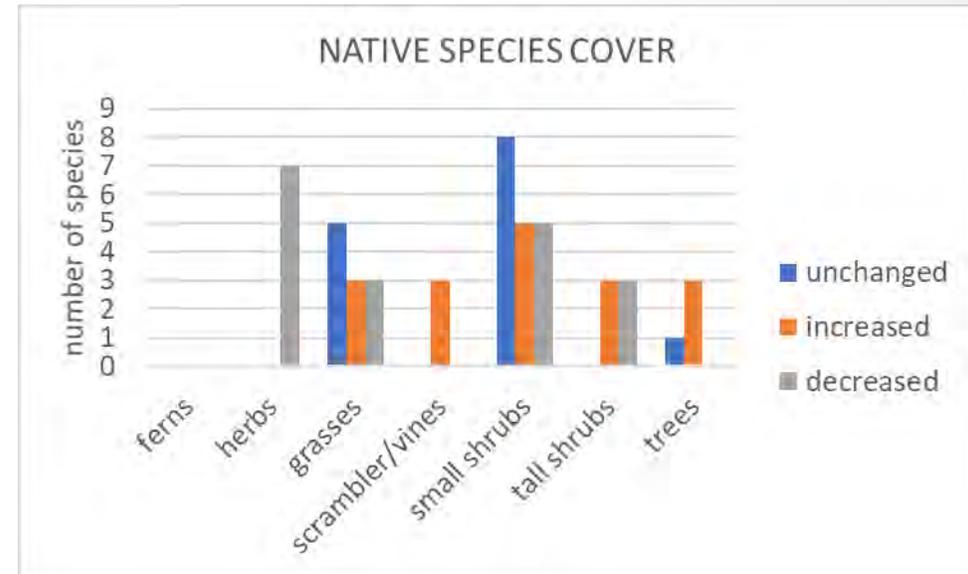
Pembroke north (TC)



Pembroke Terrys Creek



Pembroke south (TC)



Changes in vegetation over time

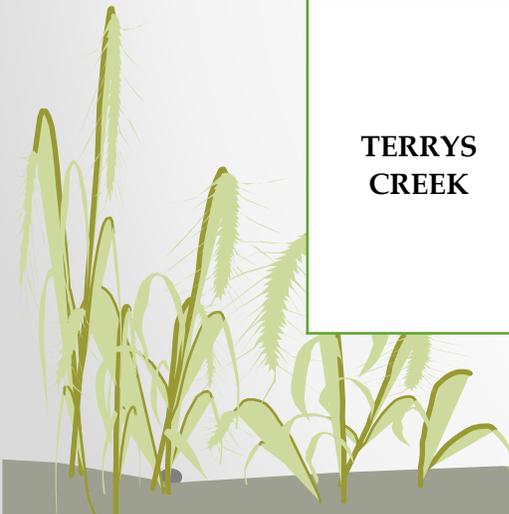
- Development of an estimate for a vegetation health trajectory for each quadrat

TRAJECTORY	DEFINING CHARACTERISTICS
DEGRADING	decrease in numbers and cover extent for native species with increase in numbers or cover extent for introduced species
MINOR DEGRADING	decrease in numbers or cover extent for native species with unchanged numbers or cover extent for introduced species OR
	unchanged numbers or cover extent for native species with increased numbers or cover extent for introduced species
STABLE	little or no change in numbers or cover extent for native species with no change in numbers or cover extent for introduced species
IMPROVING	no change or increase in numbers or cover extent for native species with no change or decrease in numbers or cover extent for introduced species



Vegetation health trajectories

RESERVE CORRIDOR	QUADRAT	NO. NATIVE SPECIES	NO. INTRODUCED SPECIES	COVER EXTENT NATIVES	COVER EXTENT INTRODUCED SPECIES	OVERALL CONDITION TRAJECTORY
BUFFALO CREEK	BURROWS PARK	decreased	decreased	decreased or unchanged	increased	DEGRADING
	PIDDING PARK	decreased	unchanged	decreased or unchanged	increased	DEGRADING
FIELD OF MARS RESERVE	STRANGERS CREEK	decreased	decreased	decreased or unchanged	unchanged	MINOR DEGRADING
	PIMELEA CURVIFLORA	unchanged	increased	unchanged or increased	increased	MINOR DEGRADING
KITTYS CREEK	KITTYS (WOLFE RD)	decreased	increased	decreased or unchanged	increased	DEGRADING
TERRYS CREEK	LUCKNOW-SOMERSET	decreased	absent	unchanged or decreased	absent	STABLE
	PEMBROKE SOUTH	decreased	unchanged	decreased or unchanged	unchanged	MINOR DEGRADING
	PEMBROKE TERRYS CREEK	increased	unchanged	increased or unchanged	unchanged	IMPROVING
	PEMBROKE NORTH	decreased	unchanged	decreased or unchanged	decreased	MINOR DEGRADING



Ground truthing vegetation mapping



The Native Vegetation of the Sydney Metropolitan Area

Volume 2: Vegetation Community Profiles

Version 3.0



Catchment Management Authority



Office of Environment & Heritage

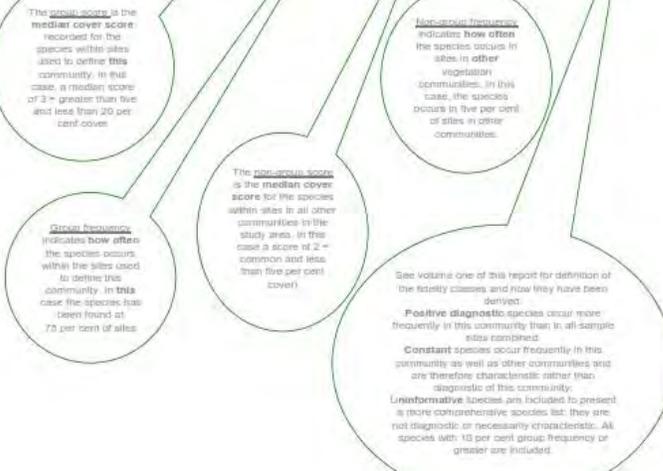
- Vegetation patches were surveyed for native flora species
- Lists of species present were compared with criteria for mapped veg communities
- Must have minimum number of species to test
- Must have minimum number of diagnostic species to satisfy identification criteria (= pass)

Species

Map Unit Code

This list comprises species that fall into one of three fidelity classes: positive diagnostic, constant and uninformative (see section 2.7.3 and section 4.12 of *The Native Vegetation of the Sydney Metropolitan Area Volume 1: Technical Report*). Fidelity classes are a measure of the relative likelihood that a species will be recorded in a 0.04 hectare systematic floristic sample site that is randomly located in the vegetation community. Obtaining such a sample is a pre-requisite for the use of the positive diagnostic species list. The number of positive diagnostic species present in a sample site can be used to identify the vegetation community by ruling out all but a few feasible alternatives. The presence of the minimum number of positive diagnostic species in a sample site is strong evidence that the sample belongs to the vegetation community. This assumes that all vascular plant species occurring in the sample site area were correctly identified and that the total number of native species recorded in the sample site exceeds the specified minimum (species-poor sites can not be tested).

Species Name	Group Score (50 Percentile)	Group Frequency	Non-group Score (50 Percentile)	Non-group Frequency	Fidelity Class
<i>Acacia murata</i>	1	25%	1	3%	Uninformative
<i>Acmena smithii</i>	3	100%	2	6%	Positive diagnostic
<i>Astrelatum formosum</i>	2	75%	2	1%	Positive diagnostic
<i>Alectryon subaeneus</i>	2	25%	1	1%	Positive diagnostic
<i>Aphanopetalum retinosam</i>	2	25%	2	0%	Positive diagnostic
<i>Arthropodium tenella</i>	2	50%	2	0%	Positive diagnostic
<i>Asplenium australasicum</i>	3	50%	1	2%	Positive diagnostic
<i>Asplenium flabellifolium</i>	2	25%	1	4%	Uninformative
<i>Baloghia inophylla</i>	3	25%	0	0%	Positive diagnostic
<i>Cerbalopetalum apetalum</i>	3	75%	2	5%	Positive diagnostic
<i>Cissampelos</i>	2	25%	2	3%	Uninformative
<i>Cissampelos</i>	2	25%	2	5%	Uninformative
<i>Cissampelos</i>	2	25%	2	1%	Positive diagnostic
<i>Clematis aristata</i>	2	50%	1	7%	Constant
<i>Clematis aristata</i>	2	25%	1	5%	Uninformative



Vegetation mapping (OEH 2016)

PLANT COMMUNITY TYPES (OEH 2016)

	SMOOTH-BARKED APPLE - RED BLOODWOOD OPEN FOREST ON ENRICHED SANDSTONE SLOPES
	COASTAL SANDSTONE GALLERY RAINFOREST
	COASTAL SHALE-SANDSTONE FOREST
	MANGROVE FOREST IN ESTUARIES OF THE SYDNEY BASIN AND SOUTH EAST CORNER
	SALTMARSH IN ESTUARIES OF THE SYDNEY BASIN AND SOUTH EAST CORNER
	SMOOTH-BARKED APPLE-BLACKBUTT-PEPPERMINT MOIST SHRUBBY FOREST IN SANDSTONE GULLY
	SWAMP OAK SWAMP FOREST FRINGING ESTUARIES, SYDNEY BASIN AND SOUTH EAST CORNER
	SYDNEY BLUE GUM-BLACKBUTT-SMOOTH-BARKED APPLE MOIST SHRUBBY OPEN FOREST ON SHALE
	SYDNEY PEPPERMINT-SMOOTH-BARKED APPLE-RED BLOODWOOD SHRUBBY OPEN FOREST ON SLOPE
	TURPENTINE-GREY IRONBARK OPEN FOREST ON SHALE IN THE SYDNEY BASIN



0 250 500

METERS

TERRYS CREEK CORRIDOR VEGETATION COMMUNITIES



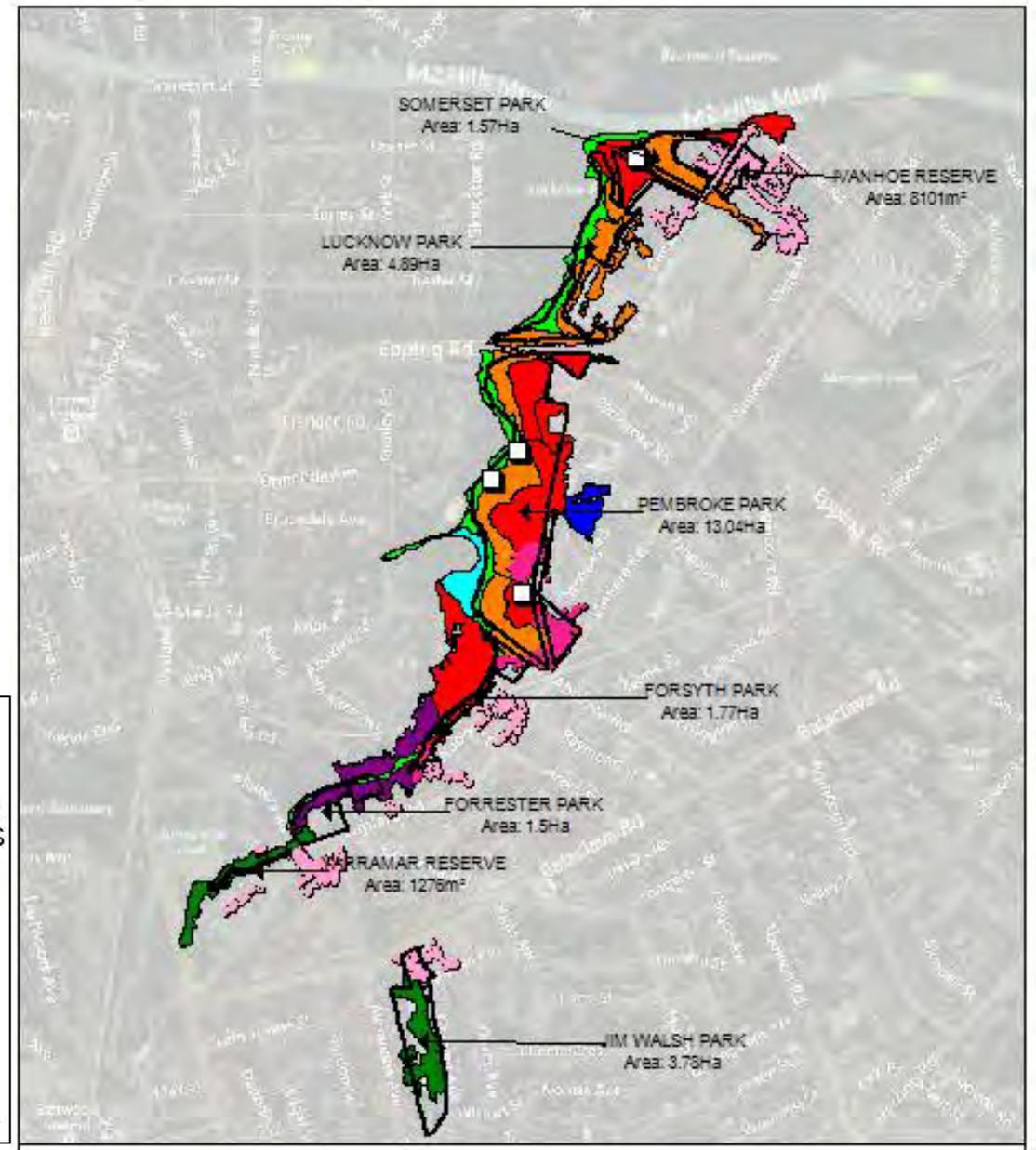
 STUDY SITE BOUNDARY

 QUADRAT

 URBAN PLANTINGS

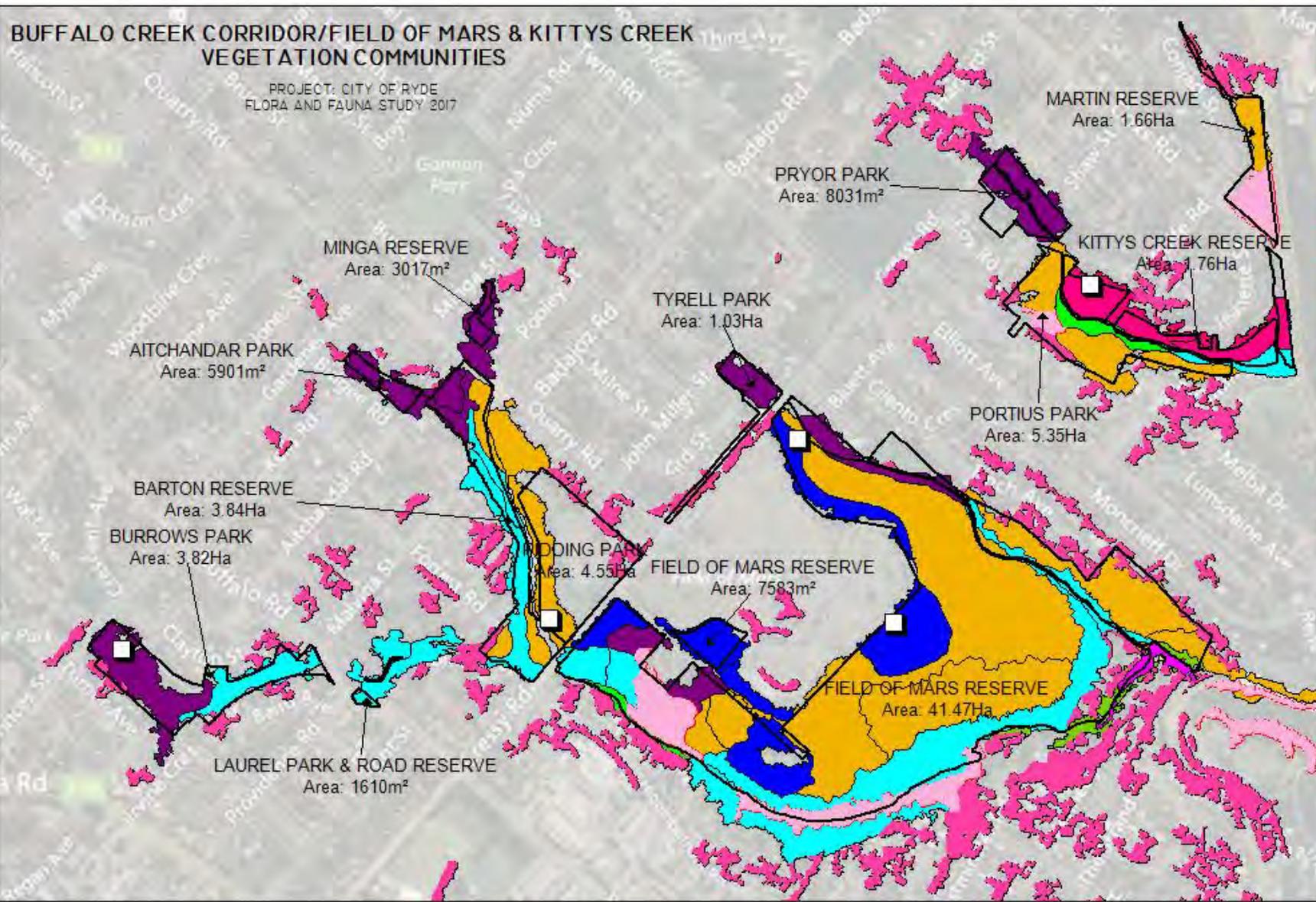
 WEEDS

PROJECT: CITY OF RYDE
FLORA AND FAUNA STUDY 2017



BUFFALO CREEK CORRIDOR/FIELD OF MARS & KITTYS CREEK VEGETATION COMMUNITIES

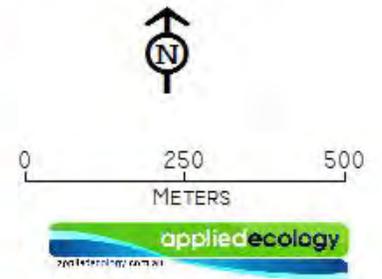
PROJECT: CITY OF RYDE
FLORA AND FAUNA STUDY 2017



PLANT COMMUNITY TYPES (OEH 2016)

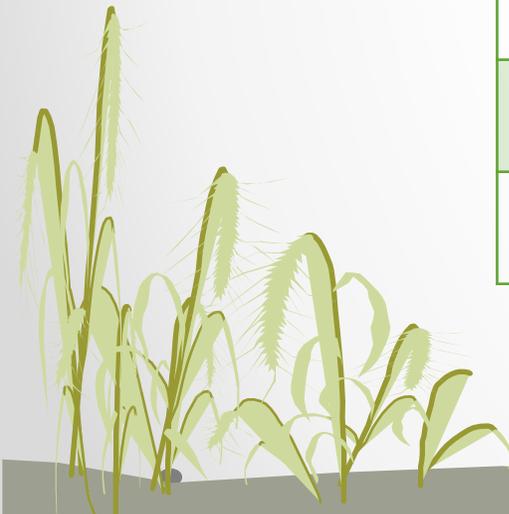
- SMOOTH-BARKED APPLE - RED BLOODWOOD OPEN FOREST ON ENRICHED SANDSTONE SLOPES
- COASTAL SANDSTONE GALLERY RAINFOREST
- COASTAL SHALE-SANDSTONE FOREST
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- SALTMARSH IN ESTUARIES OF THE SYDNEY BASIN AND SOUTH EAST CORNER
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- SYDNEY PEPPERMINT-SMOOTH-BARKED APPLE-RED BLOODWOOD SHRUBBY OPEN FOREST ON SLOPE
- TURPENTINE-GREY IRONBARK OPEN FOREST ON SHALE IN THE SYDNEY BASIN

- STUDY SITE BOUNDARY
- QUADRAT
- URBAN PLANTINGS
- WEEDS



Identifying vegetation patches

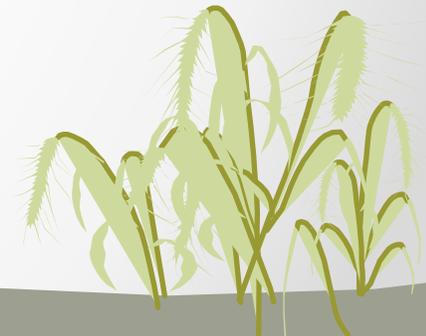
VEGETATION COMMUNITY	NSW PLANT COMMUNITY TYPES (PCTs)	# PATCHES
Coastal Enriched Sandstone Dry (previously Sheltered) Forest	Red Bloodwood - Scribbly Gum - Silvertop Ash open forest on sandstone ridges of the Woronora Plateau	15
Sydney Turpentine Ironbark Forest CEEC	Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	9
Coastal Sandstone Gully (previously Sheltered Peppermint-Apple) Forest	Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion	8
Coastal Enriched Sandstone Moist Forest	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	5
Coastal Shale Sandstone Forest	Smooth-barked Apple - Red Bloodwood - Blackbutt tall open forest on shale sandstone transition soils in eastern Sydney	5
Coastal Sandstone Gallery Rainforest	Coachwood - Lilly Pilly - Water Gum gallery rainforest in sandstone gullies of the Sydney basin	4
Blue Gum High Forest CEEC	Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin Bioregion	2
Hornsby Enriched Sandstone Exposed Woodland	Dwarf Apple - Broad-leaved Scribbly Gum - Sydney Peppermint low open woodland on sandstone ridges with subtle enrichment in northern Sydney	1



Results of ground truthing surveys

- 46 vegetation patches were ground truthed
- 6 quadrats unable to test due to insufficient species
- 9 quadrats failed for mapped veg community
- 3 quadrats retested for adjoining veg community, 2 passed, 1 failed by 1 diagnostic species

- TOTAL PATCHES MEETING DIAGNOSTIC CRITERIA = 33 confirmed communities



Targeted TS: *Melaleuca deanei*

Melaleuca deanei: (left) fruit and foliage, (right) foliage and form
(Photos: © Steve Douglas, OEH profile)



Surveys undertaken on 19/9, 27/9, 5/10, 9/11, 17/11
(flowers in summer)

Targeted TS: *Epacris purpurascens* var. *purpurascens*

Flowers in spring; confusing species include *Epacris pulchella* (flowers all year, leaves more sparse) and *Woollsia pungens* (similar leaves but has white “crumpled” looking flowers)



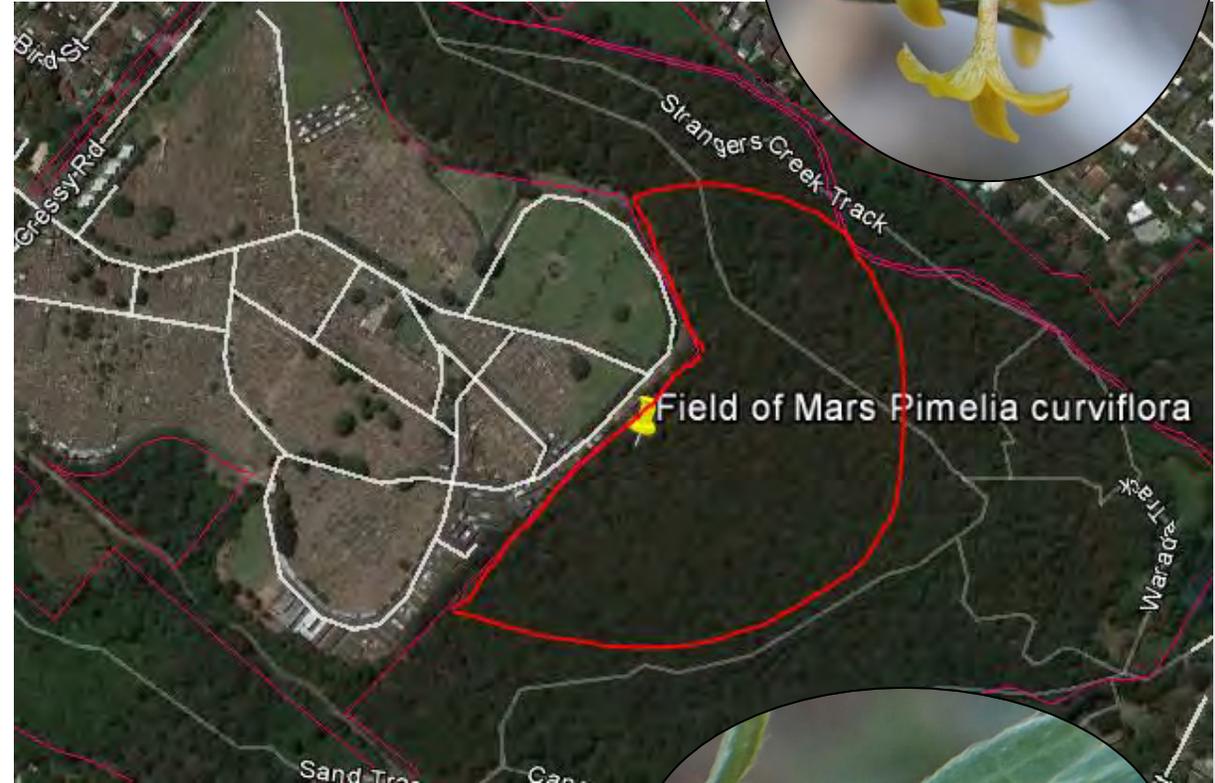
RESULTS OF SURVEYS – 6
PLANTS, 4 ADDITIONAL

Targeted TS: *Pimelea curviflora* var. *curviflora*

PREVIOUS SIGHTINGS



Survey dates: 19/9, 27/9,
5/10, 9/11, 17/11, 12/12



"will resprout from tuberous roots and rapidly flower in spring or summer following sufficient rainfall"

SURVEY RESULTS
- NOT SIGHTED



Vegetation changes over time

- Changes are primarily in species composition and/or vegetation structure
- Processes causing change can be abrupt or gradual
- Abrupt changes
 - Are usually major disturbances, usually external in origin, can be catastrophic
 - Examples include flood, fire, extreme wind and weather conditions
 - Cause rapid and often long lasting changes in vegetation composition and structure



Mechanisms of change in Ryde LGA

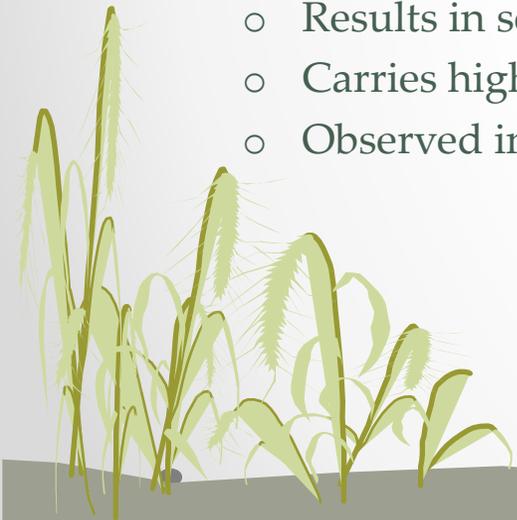
- Fire:
 - Many flora species adapted to recover from fire
 - Too frequent fire will result in loss of species from the area
 - Observed in Field of Mars Reserve
- Urban stormwater:
 - Fast time of concentration, resulting in high velocity flows
 - Causes erosion at discharge points and along streams
 - Results in sedimentation at other locations along streams
 - Carries high nutrient loads, which favour weeds over native species
 - Observed in Terrys, Kittys, Buffalo and Strangers Creeks



15 years post fire near Strangers Creek, Field of Mars Reserve

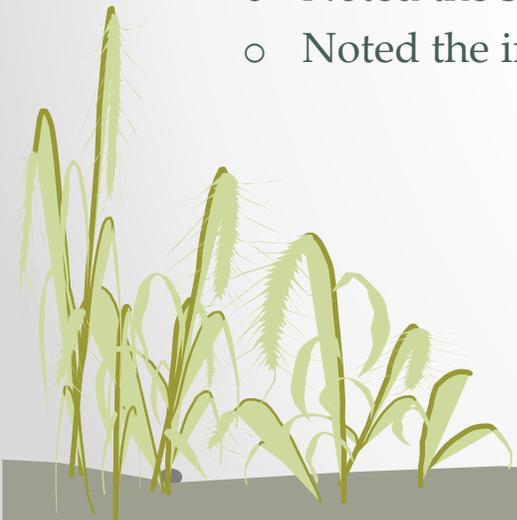


Terrys Creek after a bank overtopping storm event



How much change is reasonable?

- Literature review for vegetation change over time in Sydney's urban bushland
- Benson & Picone, 2009: repeated decadal surveys for 32 years in BGHF in Beecroft. Reported that
 - Changes in species were linked with plant form – vines increased in diversity and cover
 - Despite ongoing bush regeneration weed control, important native species declined
 - Noted the shortcomings of 'random' snapshots over time
 - Noted the importance of the soil seedbank in the community



Site history vs propagule pressure

- Site history can adversely affect native vegetation
- What about Field of Mars Reserve?
- Propagule pressure affects areas downslope from roads, and areas within the riparian corridor
- In narrow reserves both impacts are present, eg Laurel Park (Buffalo Creek) and Yarramar Reserve (upstream end of Terrys Creek)



Weeds like creeks!

- Areas within 2 m of a creek edge have higher exotic species richness and cover (Hill et al, 2004)
- Rate of spread is affected by channel form – steep banks are slower to colonise
- Also affected by nutrient levels in stormwater and frequency of bank overtopping storm events (Terrys Creek!)



Above: Laurel Park (Buffalo Creek)
Below: Yarramar Res (Terrys Creek)



Conclusions

- Decadal surveys need to be considered in context of
 - Stochastic events – climate and weather impacts
 - Localised changes – bush regeneration, erosion and stabilisation works, bushfire
- Replication can be affected by inability to relocate quadrat markers
- Understanding reference conditions for relevant vegetation communities can help to guide management
- Conservation management needs to consider internal and external impacts
- Wins should be taken at reserve or corridor level
- Losses may not be apparent for many years



FAUNA SURVEY METHODOLOGIES



BASED ON METHODS DESCRIBED BY BIOSPHERE 2006 & 2007

DIURNAL BIRDS

Listening, direct observation

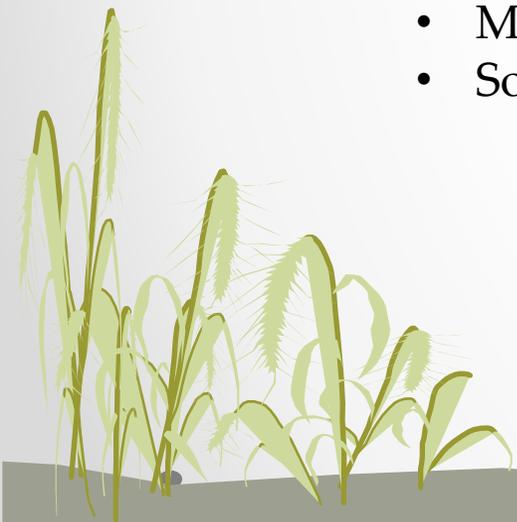
Minutes		TERRYS CREEK NORTH	TERRYS CREEK SOUTH	FIELD OF MARS RESERVE	BUFFALO CREEK TRIBS	KITTYS CREEK
autumn	# Quadrat survey	40 (2)	120(6)	80(4)	80(4)	100 (5)
	# 40 min random meanders	160(4)	200(5)	320(8)	120(3)	240(6)
spring	# Quadrat survey	60(3)	120(6)	80(4)	80(4)	40(2)
	# 40 min random meanders	240(6)	480(12)	520(13)	400(10)	480(12)
Totals		500 min, 15 surveys	920 min, 29 surveys	1000 mins, 30 surveys	680mins, 21 surveys	860 mins, 25 surveys

NOCTURNAL BIRDS

Spotlighting/listening Call playback

25W megaphone or speaker, smartphone, 50w spotlight

- Barking Owl (*Ninox connivens*)
- Eastern Barn Owl (*Tyto delicatula*),
- Masked Owl (*Tyto novaehollandiae*)
- Sooty Owl (*Tyto tenebricosa tenebricosa*)





SPOTLIGHTING

- MAMMALS
- REPTILES AND FROGS
- NOCTURNAL BIRDS
- FISH
- INVERTS



CORRIDOR	TERRYS CREEK NORTH	TERRYS CREEK SOUTH	FIELD OF MARS RESERVE	BUFFALO CREEK TRIBS	KITTYS CREEK
NIGHTS	4	4	6	4	4

Spotlighting was undertaken using 50- 100 watt hand held spotlights as appropriate which were used to sweep surrounding vegetation in search of eye-shine or animal movements. Time was spent listening for calls at 10 minute intervals for 1 minute. Creeks, soaks, surface waters were inspected for fish and frogs.



CAMERA TRAPPING

- PRIMARILY MAMMALS

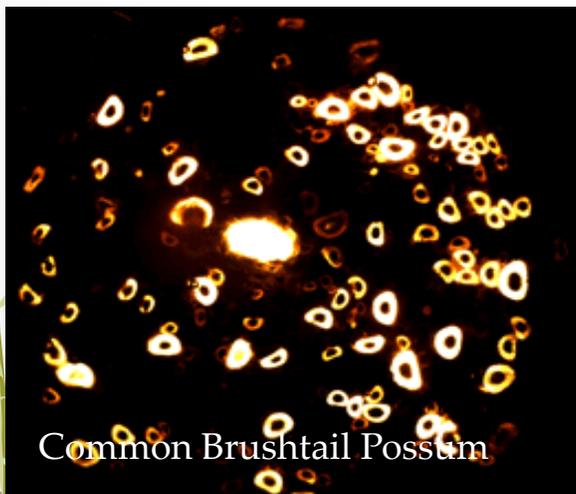
CORRIDOR	TERRYS CREEK NORTH	TERRYS CREEK SOUTH	FIELD OF MARS	BUFFALO CREEK TRIBS	KITTYS CREEK
NIGHTS	80	118	204	61	150



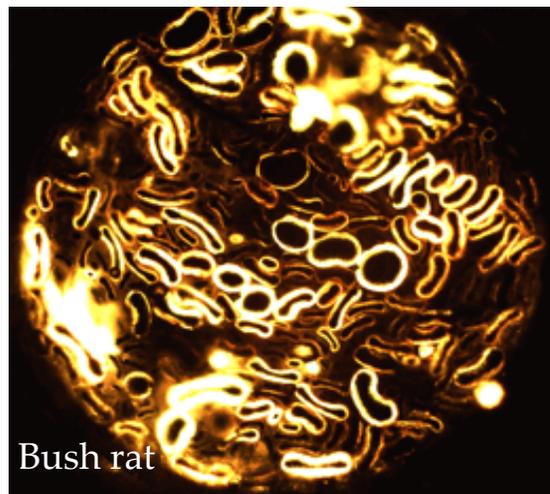
HAIRTUBES

- **MAMMAL SPECIFIC**

MAJOR CORRIDOR NAME	MINIMUM EFFORT
	HAIRTUBE NIGHTS PER SEASON
Terrys Creek	200
Buffalo Creek	250
Kittys Creek	150



Common Brushtail Possum



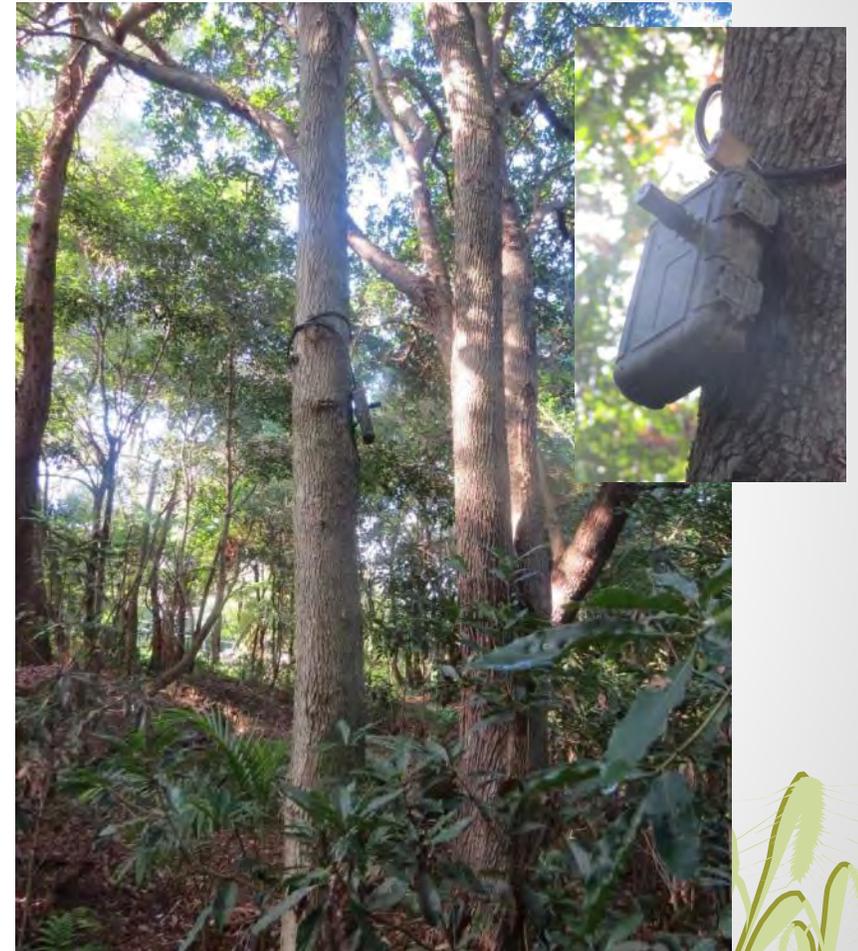
Bush rat



MICROBATS – SURVEY METHODS

NIGHTS	TERRYS CREEK NORTH	TERRYS CREEK SOUTH	FIELD OF MARS	BUFFALO CREEK TRIBS	KITTYS CREEK
Autumn	8	8	15	7	7
Spring	7	7	32	18	8

1. Deployed at fixed locations in reserves for 5 to 7 nights (depending on weather)
2. Carried through the reserve during spotlighting surveys



QUAD 20 MINUTE TIME SEARCHES

- Reptiles and frogs
- Inverts

2 SEARCHES PER SEASON PER QUAD

OTHER SEARCHES

- Fish, tadpoles, macroinvertebrates
20 minute dip netting + observations
- Inverts
ad hoc observations during other survey activities
- Mammals +
searches for evidence – scats, diggings, nests etc.



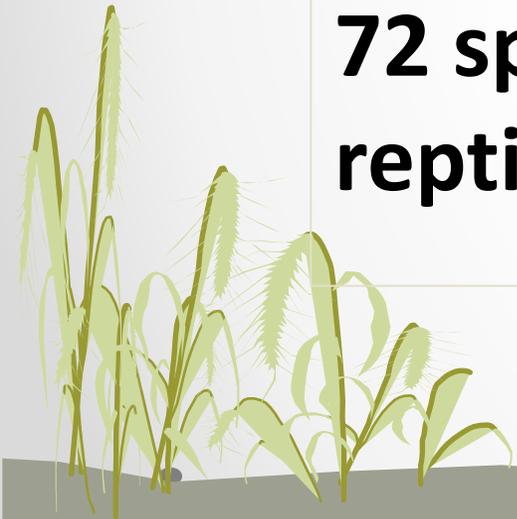


RESULTS FAUNA

114 vertebrate species were detected during the survey including:

- 5 threatened species
- 2 species listed under the Bonn convention
- 10 exotic species

72 species of bird, 22 mammals, 4 amphibians, 12 reptiles, 4 fish were recorded.



Native Mammals



Common Brushtail Possum	<i>Trichosurus vulpecula</i>	
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	FED-V
Long-nosed Bandicoot	<i>Perameles nasuta</i>	
Short-beaked echidna	<i>Tachyglossus aculeatus</i>	
Sugar Glider	<i>Petaurus breviceps</i>	
Swamp Wallaby	<i>Wallabia bicolor</i>	
White-striped Free-tailed Bat	<i>Austronomus australis</i>	
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	
	<i>Miniopterus orianae oceanensis</i>	
Eastern Bentwing-bat		NSW-V
Ride's Free-tailed Bat	<i>Mormopterus ridei</i>	
Large-footed Myotis	<i>Myotis macropus</i>	NSW-V
a Long-eared Bat	<i>Nyctophilus sp</i>	
Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>	NSW-V
Large Forest Bat	<i>Vespadelus darlingtoni</i>	



Exotic Mammals

Black Rat	<i>Rattus rattus</i>
Cat (sighted/cams)	<i>Felis catus</i>
Dog (spotlighting)	<i>Canis lupus familiaris</i>
House Mouse	<i>Mus musculus</i>
Rabbit	<i>Oryctolagus cuniculus</i>
Red Fox	<i>Vulpes vulpes</i>



Reptiles & amphibians

Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>
Bar-sided Skink	<i>Concinna tenuis</i>
Broad-tailed gecko	<i>Phyllurus platurus</i>
Eastern Blue-tongue Lizard	<i>Tiliqua scincoides</i>
Eastern Long-necked Turtle	<i>Chelodina longicollis</i>
Eastern Water Dragon	<i>Intellagama lesueurii</i>
Eastern Water-skink	<i>Eulamprus quoyii</i>
Elegant Snake-eyed Skink	<i>Cryptoblepharus pulcher</i>
Pale-flecked Garden Sunskink	<i>Lampropholis guichenoti</i>
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>
Three-toed Skink	<i>Saiphos equalis</i>
Weasel Skink	<i>Saproscincus mustelinus</i>

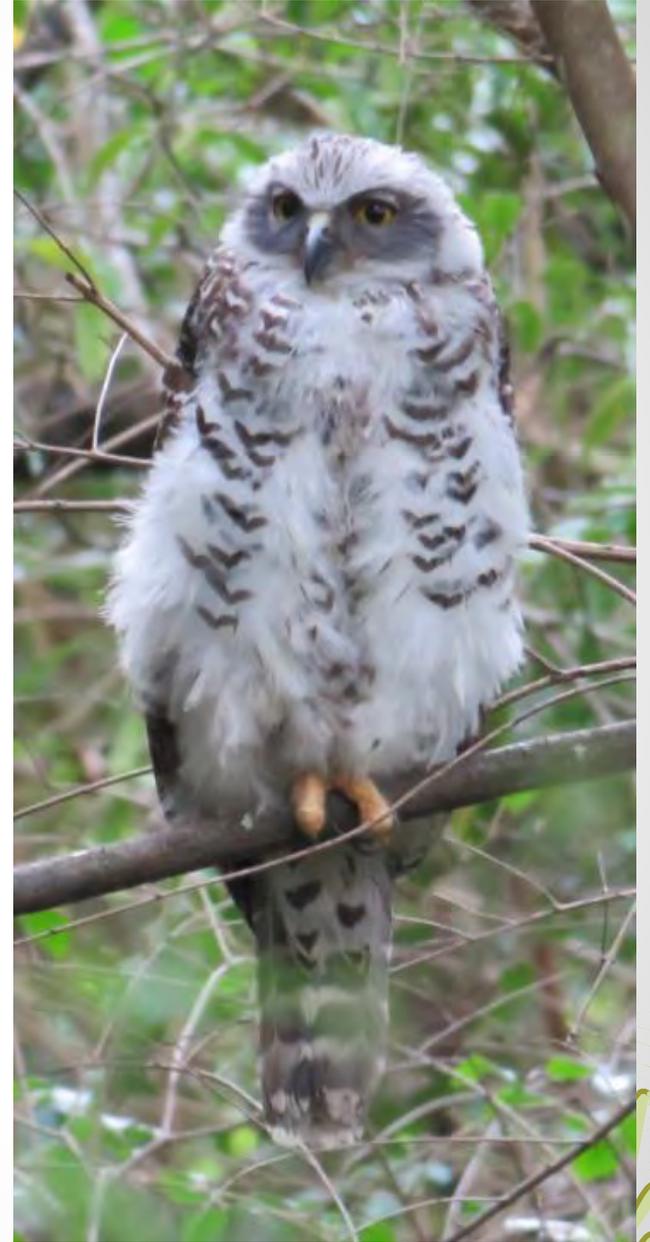
Striped Marsh Frog	<i>Limnodynastes peronii</i>
Common Eastern Froglet	<i>Crinia signifera</i>
Green Stream Frog	<i>Litoria phyllochroa</i>
Perons Tree Frog	<i>Litoria peronii</i>





KITTYS CREEK

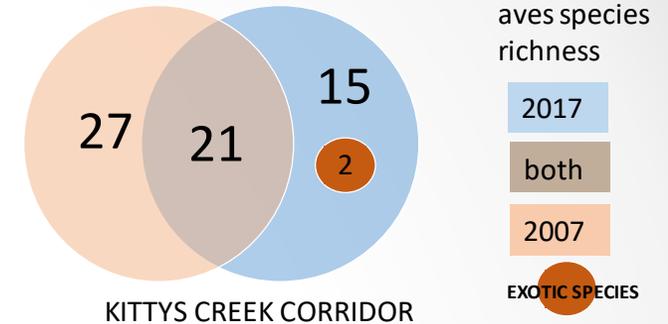
CLASS	2007	2017
BIRDS	47	36
REPTILES	7	6
FROGS	3	4
MAMMALS	7	17
TOTAL	64	63



Australian Brush-turkey	<i>Alectura lathami</i>
Australian King-Parrot	<i>Alisterus scapularis</i>
Australian Magpie	<i>Cracticus tibicen</i>
Australian Raven	<i>Corvus coronoides</i>
Australian White Ibis	<i>Threskiornis molucca</i>
Australian Wood Duck	<i>Chenonetta jubata</i>
Brown Gerygone	<i>Gerygone mouki</i>
Brown Goshawk	<i>Accipiter fasciatus</i>
	<i>Scythrops</i>
Channel-billed Cuckoo	<i>novaehollandiae</i>
Common Myna	<i>Sturnus tristis</i>
Crested Pigeon	<i>Ocyphaps lophotes</i>
Crimson Rosella	<i>Platycercus elegans</i>
Eastern Koel	<i>Eudynamys orientalis</i>
Eastern Rosella	<i>Platycercus eximius</i>
Eastern Whipbird	<i>Psophodes olivaceus</i>
Eastern Yellow Robin	<i>Eopsaltria australis</i>
Laughing Kookaburra	<i>Dacelo novaeguineae</i>
Little Corella	<i>Cacatua sanguinea</i>
Magpie-lark	<i>Grallina cyanoleuca</i>
Masked Lapwing	<i>Vanellus miles</i>
	<i>Manorina</i>
Noisy Miner	<i>melanocephala</i>
Pacific Black Duck	<i>Anas superciliosa</i>
Pied Currawong	<i>Strepera graculina</i>

BIRDS – KITTY'S CREEK

Powerful Owl	<i>Ninox strenua</i>
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>
Red Wattlebird	<i>Anthochaera carunculata</i>
Rufous Fantail	<i>Rhipidura rufifrons</i>
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>
Spotted Pardalote	<i>Pardalotus punctatus</i>
Spotted Turtle-Dove	<i>Streptopelia chinensis</i>
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>
Superb Fairy-wren	<i>Malurus cyaneus</i>
Tawny Frogmouth	<i>Podargus strigoides</i>
Welcome Swallow	<i>Hirundo neoxena</i>
White-browed Scrubwren	<i>Sericornis frontalis</i>
Willie Wagtail	<i>Rhipidura leucophrys</i>



2017 - CURRENT SURVEYS



2007 - PAST SURVEYS



NEW OBSERVATIONS

Australian Brush-turkey	<i>Alectura lathami</i>
Australian King-Parrot	<i>Alisterus scapularis</i>
Australian Raven	<i>Corvus coronoides</i>
Australian Wood Duck	<i>Chenonetta jubata</i>
Brown Gerygone	<i>Gerygone mouki</i>
Brown Goshawk	<i>Accipiter fasciatus</i>
Common Myna*	<i>Sturnus tristis</i>
Eastern Whipbird	<i>Psophodes olivaceus</i>
Eastern Yellow Robin	<i>Eopsaltria australis</i>
Masked Lapwing	<i>Vanellus miles</i>
Pacific Black Duck	<i>Anas superciliosa</i>
Powerful Owl	<i>Ninox strenua</i>
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>
Spotted Turtle-Dove*	<i>Streptopelia chinensis</i>
White-browed Scrubwren	<i>Sericornis frontalis</i>

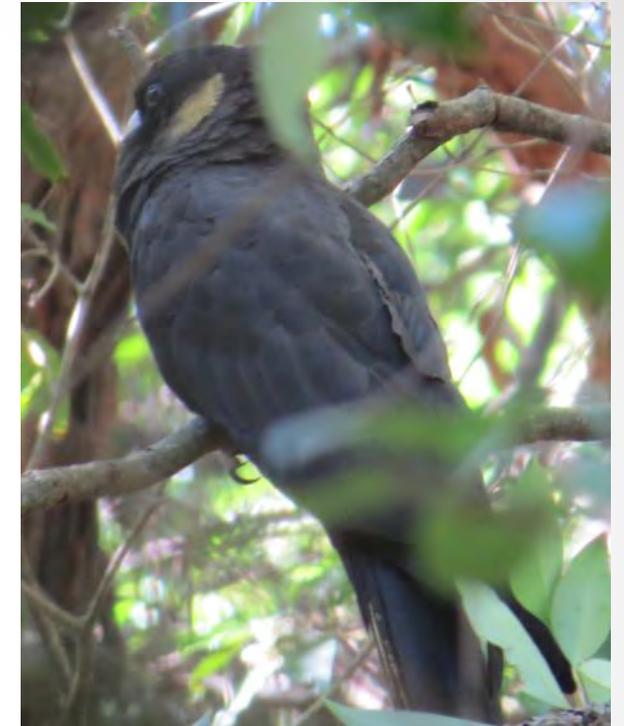


NOT DETECTED

Australian Hobby	<i>Falco longipennis</i>
Australian Pelican	<i>Pelecanus conspicillatus</i>
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>
Black-faced Monarch	<i>Monarcha melanopsis</i>
Brown Thornbill	<i>Acanthiza pusilla</i>
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>
Galah	<i>Eolophus roseicapillus</i>
Great Egret	<i>Ardea alba</i>
Grey Butcherbird	<i>Cracticus torquatus</i>
Grey Fantail	<i>Rhipidura albiscapa</i>
Jacky winter	<i>Microeca fascinans</i>
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>
Long-billed Corella	<i>Cacatua tenuirostris</i>
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>
Olive-backed Oriole	<i>Oriolus sagittatus</i>
Pied Cormorant	<i>Phalacrocorax varius</i>
Red Wattlebird	<i>Anthochaera carunculata</i>
Rufous Whistler	<i>Pachycephala rufiventris</i>
Sacred Kingfisher	<i>Todiramphus sanctus</i>
Silver Gull	<i>Chroicocephalus novaehollandiae</i>
Silvereye	<i>Zosterops lateralis westernensis/lat</i>
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>
White-throated Tree-creeper	<i>Cormobates leucophaea</i>
White-throated Needletail	<i>Hirundapus caudacutus</i>
Yellow Thornbill	<i>Acanthiza nana</i>
Yellow-faced Honeyeater	<i>Lichenostomus chrysops chrysops</i>

TERRYS CREEK

CLASS	2007	2017
BIRDS	63	53
REPTILES	7	9
FROGS	3	4
MAMMALS	7	19
TOTAL	92	87

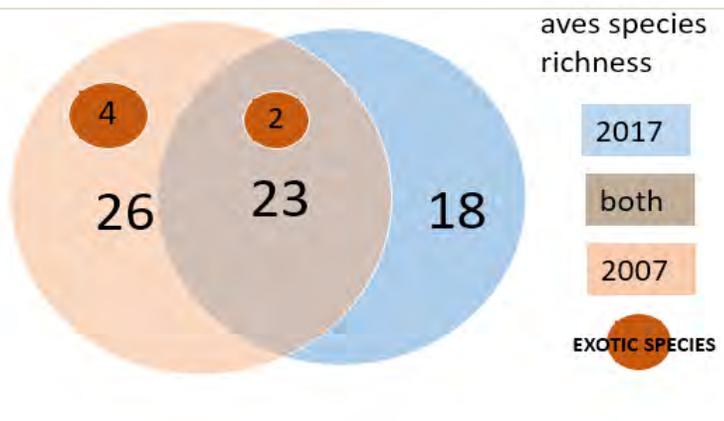


BIRDS –TERRYS CREEK

Australian Brush-turkey	<i>Alectura lathamii</i>
Australian King-Parrot	<i>Alisterus scapularis</i>
Australian Magpie	<i>Cracticus tibicen</i>
Australian Raven	<i>Corvus coronoides</i>
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>
Brown Gerygone	<i>Gerygone mouki</i>
Brown Thornbill	<i>Acanthiza pusilla</i>
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>
Common Myna*	<i>Sturnus tristis</i>
Crested Pigeon	<i>Ocyphaps lophotes</i>
Crimson Rosella	<i>Platycercus elegans</i>
Dollar Bird	<i>Eurystomus orientalis</i>
Eastern Koel	<i>Eudynamis orientalis</i>
Eastern Rosella	<i>Platycercus eximius</i>
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>
Eastern Whipbird	<i>Psophodes olivaceus</i>
Eastern Yellow Robin	<i>Eopsaltria australis</i>
Golden Whistler	<i>Pachycephala pectoralis</i>
Grey Fantail	<i>Rhipidura albiscapa</i>
Grey Goshawk	<i>Accipiter novaehollandiae</i>
Laughing Kookaburra	<i>Dacelo novaeguineae</i>
Leaden Flycatcher	<i>Myiagra rubecula</i>
Lewins Honeyeater	<i>Meliphaga lewinii</i>
Little Corella	<i>Cacatua sanguinea</i>
Little Wattlebird	<i>Anthochaera chrysoptera</i>
Magpie-lark	<i>Grallina cyanoleuca</i>
Noisy Miner	<i>Manorina melanocephala</i>

Olive-backed Oriole	<i>Oriolus sagittatus</i>
Pacific Black Duck	<i>Anas superciliosa</i>
Pied Currawong	<i>Strepera graculina</i>
Powerful Owl	<i>Ninox strenua</i>
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>
Red Wattlebird	<i>Anthochaera carunculata</i>
Red-browed Finch	<i>Neochmia temporalis</i>
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>
Rufous Whistler	<i>Pachycephala rufiventris</i>
Sacred Kingfisher	<i>Todiramphus sanctus</i>
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>
Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>
	<i>Zosterops lateralis</i>
Silvereye	<i>westernensis/lateralis lateralis</i>
Spotted Pardalote	<i>Pardalotus punctatus</i>
Spotted Turtle-Dove*	<i>Streptopelia chinensis</i>
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>
Superb Fairy-wren	<i>Malurus cyaneus</i>
Superb Lyrebird	<i>Menura novaehollandiae</i>
Variiegated Fairy-wren	<i>Malurus lamberti</i>
White-browed Scrubwren	<i>Sericornis frontalis</i>
White-cheeked Honeyeater	<i>Phylidonyris niger</i>
White-headed Pigeon	<i>Columba leucomela</i>
White-throated Tree-creeper	<i>Cormobates leucophaea</i>
Yellow Thornbill	<i>Acanthiza nana</i>
	<i>Lichenostomus chrysops</i>
Yellow-faced Honeyeater	<i>chrysops</i>
Yellow-tailed Black Cockatoo	<i>Calyptorhynchus funereus</i>

NORTH



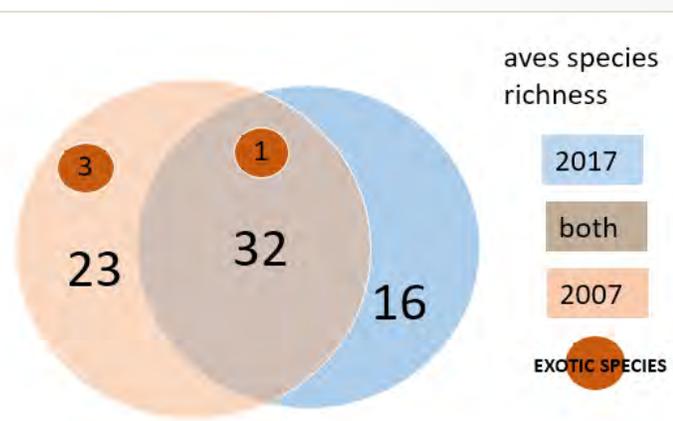
2017 - CURRENT SURVEYS - TERRY'S CREEK NORTH



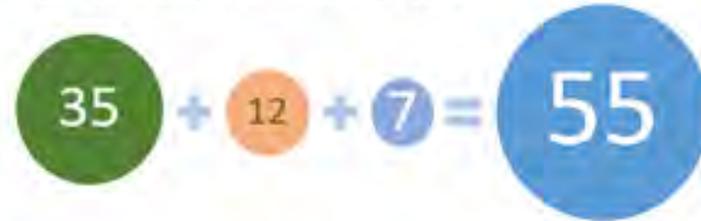
2007 - PAST SURVEYS - TERRY'S CREEK NORTH



SOUTH



2007 - CURRENT SURVEYS - TERRY'S CREEK SOUTH



2017 - CURRENT SURVEYS - TERRY'S CREEK SOUTH



Buffalo Creek & Field of Mars Reserve

Buffalo creek

CLASS	2007	2017
BIRDS	42	47
REPTILES	5	6
FROGS	3	4
MAMMALS	8	13
TOTAL	58	70

Field of Mars Reserve

CLASS	2006	2016	2017
BIRDS	43	61	63
REPTILES	10	10	9
FROGS	4	4	4
MAMMALS	15	15	17
TOTAL	72	90	93



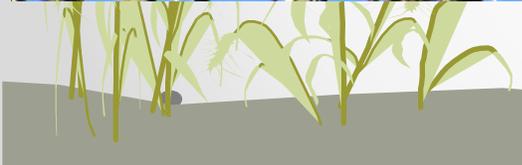
Birds

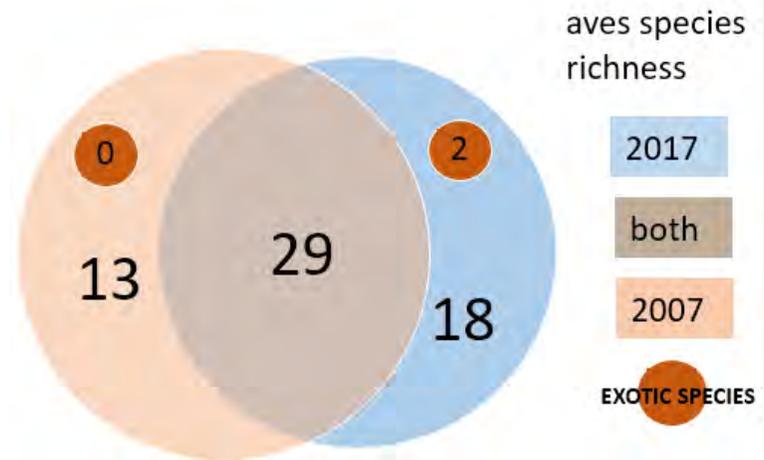
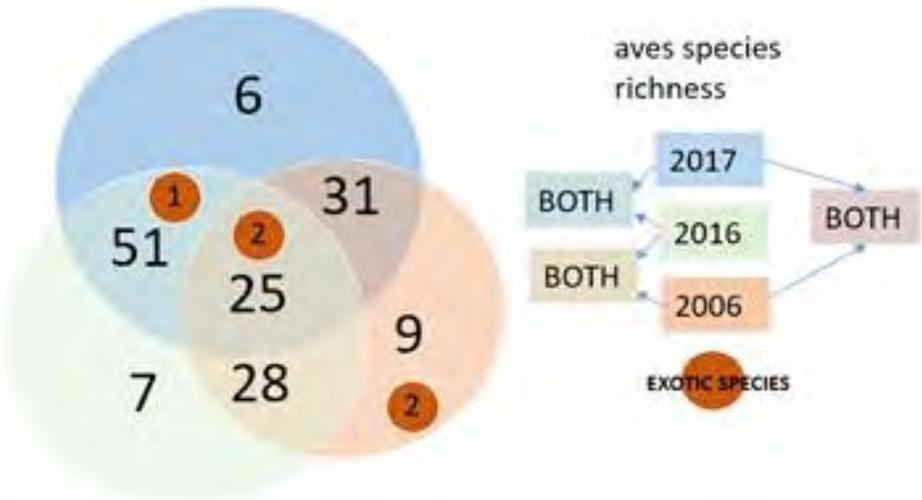
Australian Brush-turkey	<i>Alectura lathamii</i>
Australian King-Parrot	<i>Alisterus scapularis</i>
Australian Magpie	<i>Cracticus tibicen</i>
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>
Australian Raven	<i>Corvus coronoides</i>
Australian White Ibis	<i>Threskiornis molucca</i>
Australian Wood Duck	<i>Chenonetta jubata</i>
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>
Black-faced Monarch	<i>Monarcha melanopsis</i>
Brown Gerygone	<i>Gerygone mouki</i>
Brown Goshawk	<i>Accipiter fasciatus</i>
Brown Thornbill	<i>Acanthiza pusilla</i>
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>
Chestnut Teal	<i>Anas castanea</i>
Common Myna*	<i>Sturnus tristis</i>
Crested Pigeon	<i>Ocyphaps lophotes</i>
Crimson Rosella	<i>Platycercus elegans</i>
Eastern Koel	<i>Eudynamys orientalis</i>
Eastern Rosella	<i>Platycercus eximius</i>
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>
Eastern Whipbird	<i>Psophodes olivaceus</i>
Eastern Yellow Robin	<i>Eopsaltria australis</i>
Galah	<i>Eolophus roseicapillus</i>
Golden Whistler	<i>Pachycephala pectoralis</i>
Grey Butcherbird	<i>Cracticus torquatus</i>
Grey Fantail	<i>Rhipidura albiscapa</i>
Laughing Kookaburra	<i>Dacelo novaeguineae</i>
Leaden Flycatcher	<i>Myiagra rubecula</i>
Lewins Honeyeater	<i>Meliphaga lewinii</i>
Little Corella	<i>Cacatua sanguinea</i>
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>

Little Wattlebird	<i>Anthochaera chrysoptera</i>
Magpie-lark	<i>Grallina cyanoleuca</i>
Masked Lapwing	<i>Vanellus miles</i>
Musk Lorikeet	<i>Glossopsitta concinna</i>
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>
Noisy Friarbird	<i>Philemon corniculatus</i>
Noisy Miner	<i>Manorina melanocephala</i>
Pacific Black Duck	<i>Anas superciliosa</i>
Pied Currawong	<i>Strepera graculina</i>
Powerful Owl	<i>Ninox strenua</i>
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>
Red Wattlebird	<i>Anthochaera carunculata</i>
Red-browed Finch	<i>Neochmia temporalis</i>
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>
Sacred Kingfisher	<i>Todiramphus sanctus</i>
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>
Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>
	<i>Zosterops lateralis</i>
Silvereye	<i>westernensis/lateralis lateralis</i>
Spotted Pardalote	<i>Pardalotus punctatus</i>
Spotted Turtle-Dove*	<i>Streptopelia chinensis</i>
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>
Superb Fairy-wren	<i>Malurus cyaneus</i>
Tawny Frogmouth	<i>Podargus strigoides</i>
Variigated Fairy-wren	<i>Malurus lamberti</i>

Welcome Swallow	<i>Hirundo neoxena</i>
White-browed Scrubwren	<i>Sericornis frontalis</i>
White-cheeked Honeyeater	<i>Phylidonyris niger</i>
White-faced Heron	<i>Egretta novaehollandiae</i>
White-throated Tree-creeper	<i>Cormobates leucophaea</i>
White-winged Triller	<i>Lalage sueurii</i>
Willie Wagtail	<i>Rhipidura leucophrys</i>
Yellow Thornbill	<i>Acanthiza nana</i>
	<i>Lichenostomus chrysops</i>
Yellow-faced Honeyeater	<i>chrysops</i>
Yellow-tailed Black Cockatoo	<i>Calyptorhynchus funereus</i>







2006 - CURRENT SURVEYS - FIELD OF MARS



2017 - CURRENT SURVEYS - FIELD OF MARS



2007 - CURRENT SURVEYS

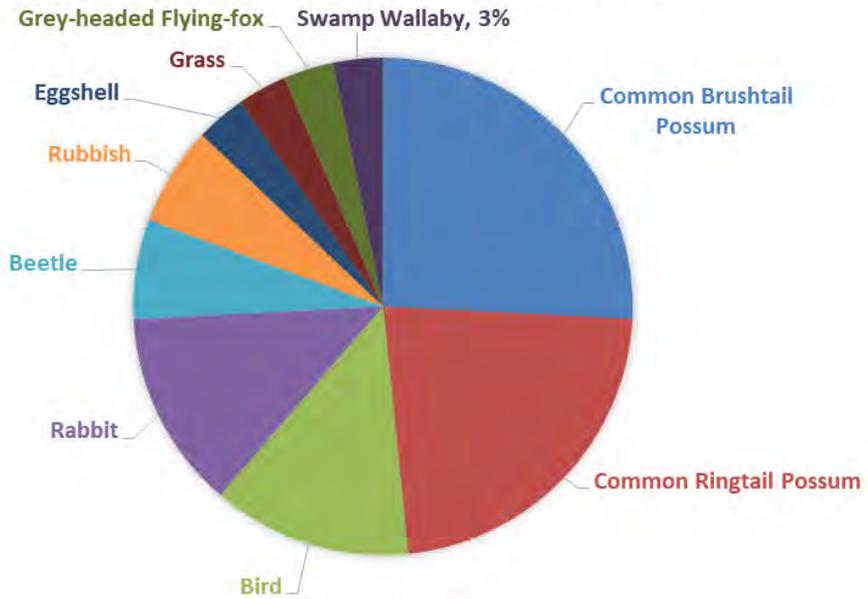


2017 - CURRENT SURVEYS

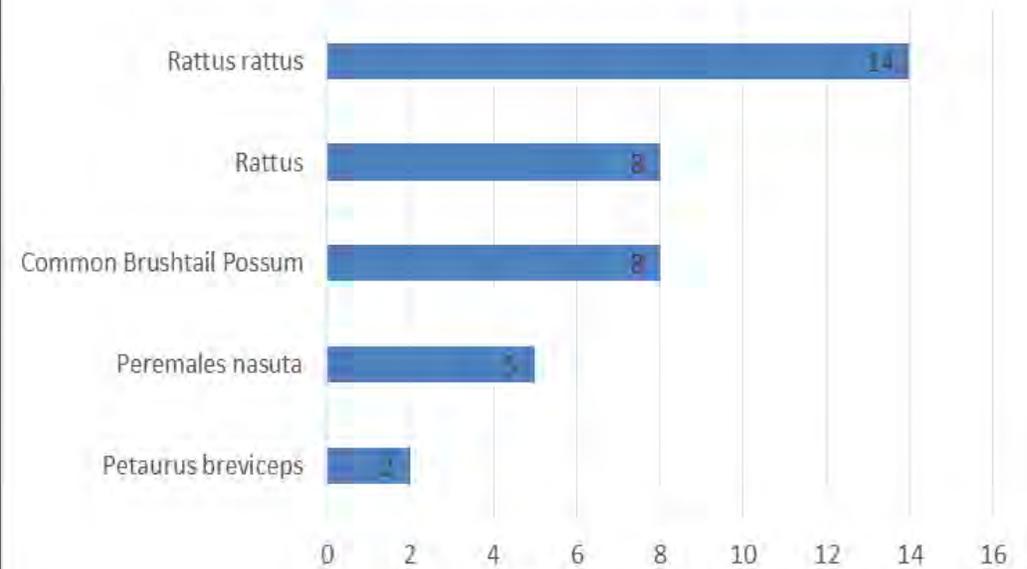


OTHER SURVEY RESULTS

PREY ITEMS PRESENT IN FOX SCATS



HAIRTUBE RESULTS



MICROBAT SURVEYS

City of Ryde, Lane Cove River drainages

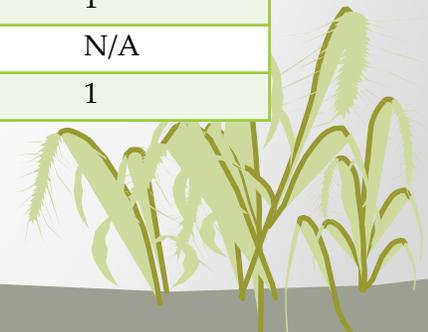
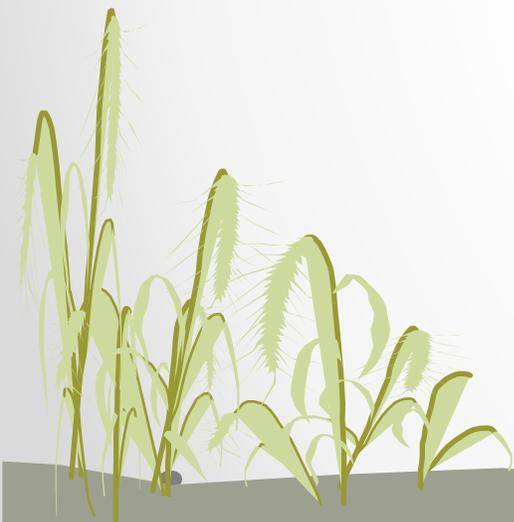


RESULTS OF 2017 SURVEYS



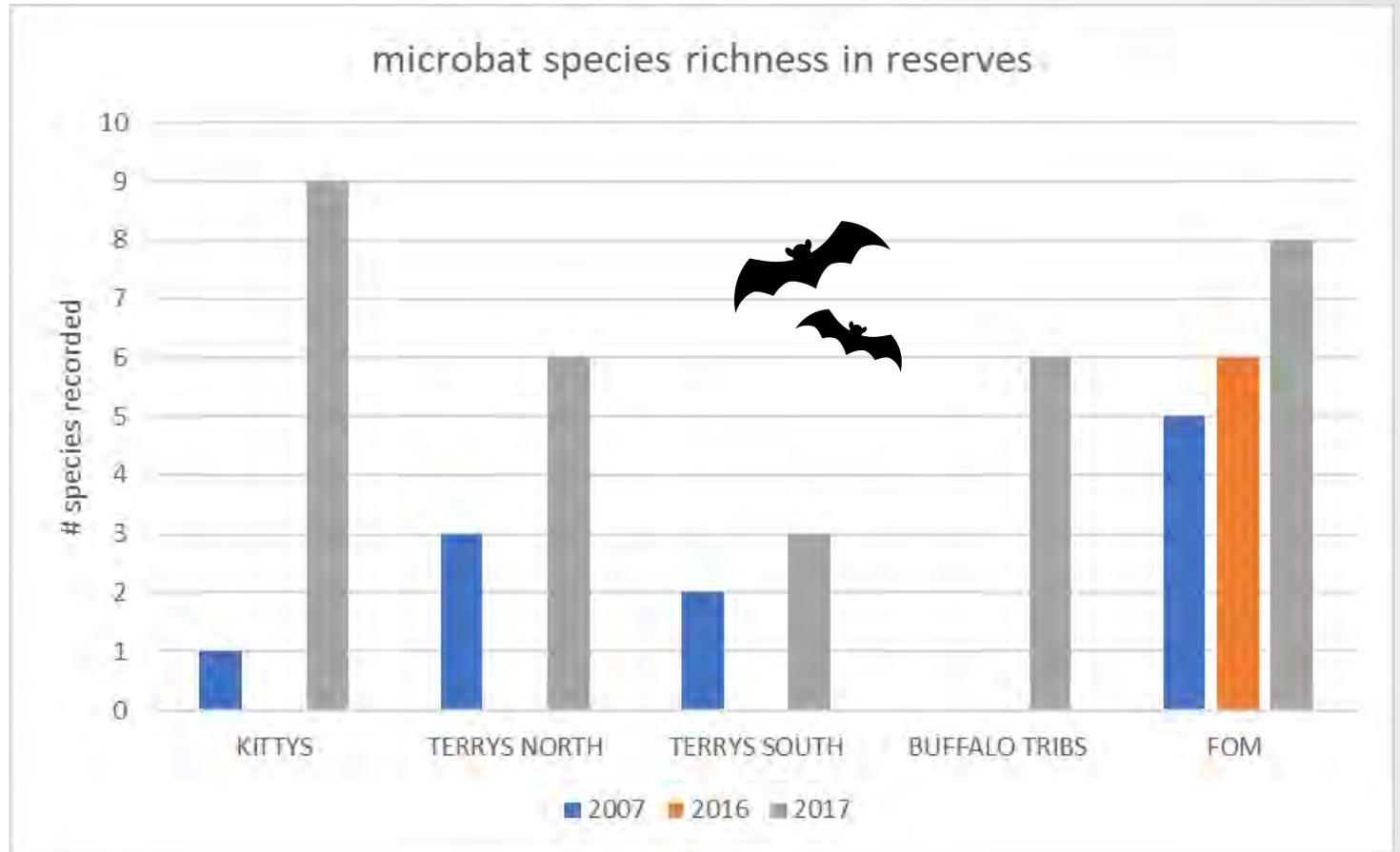
- 12 species recorded in 2017, 3 in all of the reserve corridors
- 4 threatened species (Vulnerable under Biodiversity Conservation Act 2016)

COMMON NAME	SPECIES NAME	BioCon Act	# RESERVES
White-striped Free-tailed Bat	<i>Austronomus australis</i>		5
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		4
Chocolate Wattled Bat	<i>Chalinolobus morio</i>		3
Eastern Bentwing-bat	<i>Miniopterus orianae oceanensis</i>	V	4
East-coast Free-tailed Bat	<i>Mormopterus norfolkensis</i>	V	1
Ride's Free-tailed Bat	<i>Mormopterus ridei</i>		5
Large-footed Myotis	<i>Myotis macropus</i>	V	2
a Long-eared Bat	<i>Nyctophilus sp</i>		5
Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>	V	4
Large Forest Bat	<i>Vespadelus darlingtoni</i>		1
Southern Forest bat	<i>Vespadelus regulus</i>		1
A forest bat	<i>Vespadelus sp</i>		N/A
Little Forest Bat	<i>Vespadelus vulturnus</i>		1



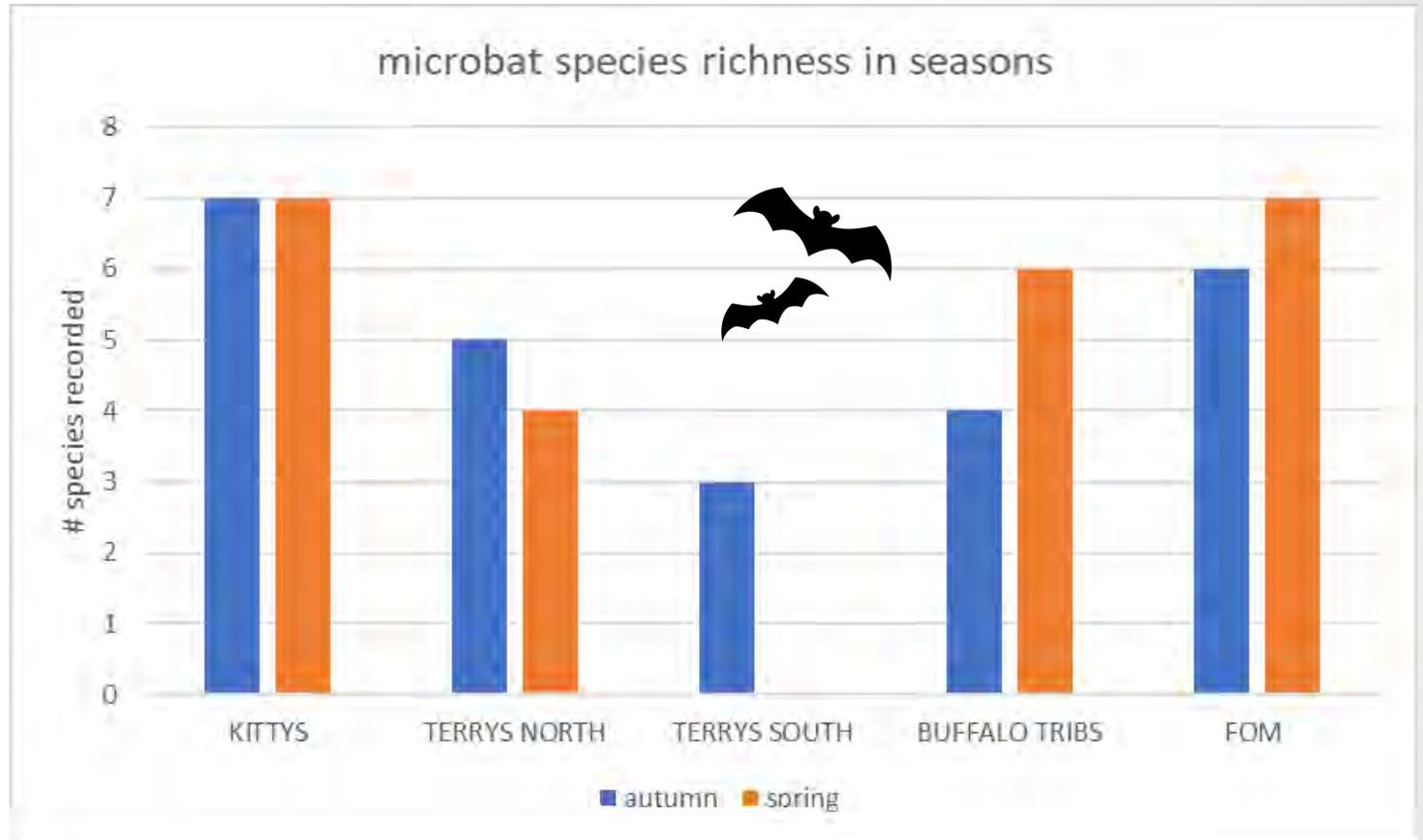
COMPARISON WITH 2007 SURVEY

- More species recorded in 2017
- Explanations include better equipment, increased survey effort
- Targeted surveys included waterways and forested areas



SEASONAL VARIATION IN 2017

- Maximum of 7 species recorded in any given reserve in either season
- Greatest diversity in Kittys Creek!
- Closely followed by FOM...
- Most important finding was the almost complete absence of forest bats (*Vespadelus* species)



HABITAT PARTITIONING

SPECIES NAME	COMMON NAME	ECHOLOCATION FREQUENCY	FLIGHT PATTERNS	FORAGING NICHE**	SENSITIVE TO URBANISATION*	CORRIDORS PRESENT
<i>Austronomus australis</i>	White-striped Free-tailed Bat	low	fast, low manoeuvrability	Open	tolerant	5
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	low	fast, high manoeuvrability	Edge	tolerant	4
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	high	fast, moderate manoeuvrability	Edge	moderately sensitive	3
<i>Miniopterus orianae oceanensis</i>	Eastern Bentwing Bat	medium	fast, moderate manoeuvrability	Edge	tolerant	4
<i>Mormopterus norfolkensis</i>	East-coast Free-tailed Bat	low	fast, low manoeuvrability	Open	moderately sensitive	2016 only
<i>Mormopterus ridei</i>	Ride's Free-tailed Bat	low	medium, moderate manoeuvrability	Open	tolerant	5
<i>Myotis macropus</i>	Large-footed Myotis	linear	medium, moderate manoeuvrability	Clutter	very sensitive	2
<i>Nyctophilus sp</i>	a Long-eared Bat	linear	slow, high manoeuvrability	Clutter	moderately sensitive	5
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	low	fast, low manoeuvrability	Open	unknown	4
<i>Vespadelus darlingtoni</i>	Large Forest Bat	medium	fast, moderate manoeuvrability	Clutter	unknown	1
<i>Vespadelus regulus</i>	Southern Forest Bat	medium	fast, moderate manoeuvrability	Clutter	moderately sensitive	2016 only
<i>Vespadelus vulturinus</i>	Little Forest Bat	high	fast, high manoeuvrability	Clutter	moderately sensitive	2016 only #

** Foraging spaces were defined following Milne et al (2004) and Adams et al (2009);

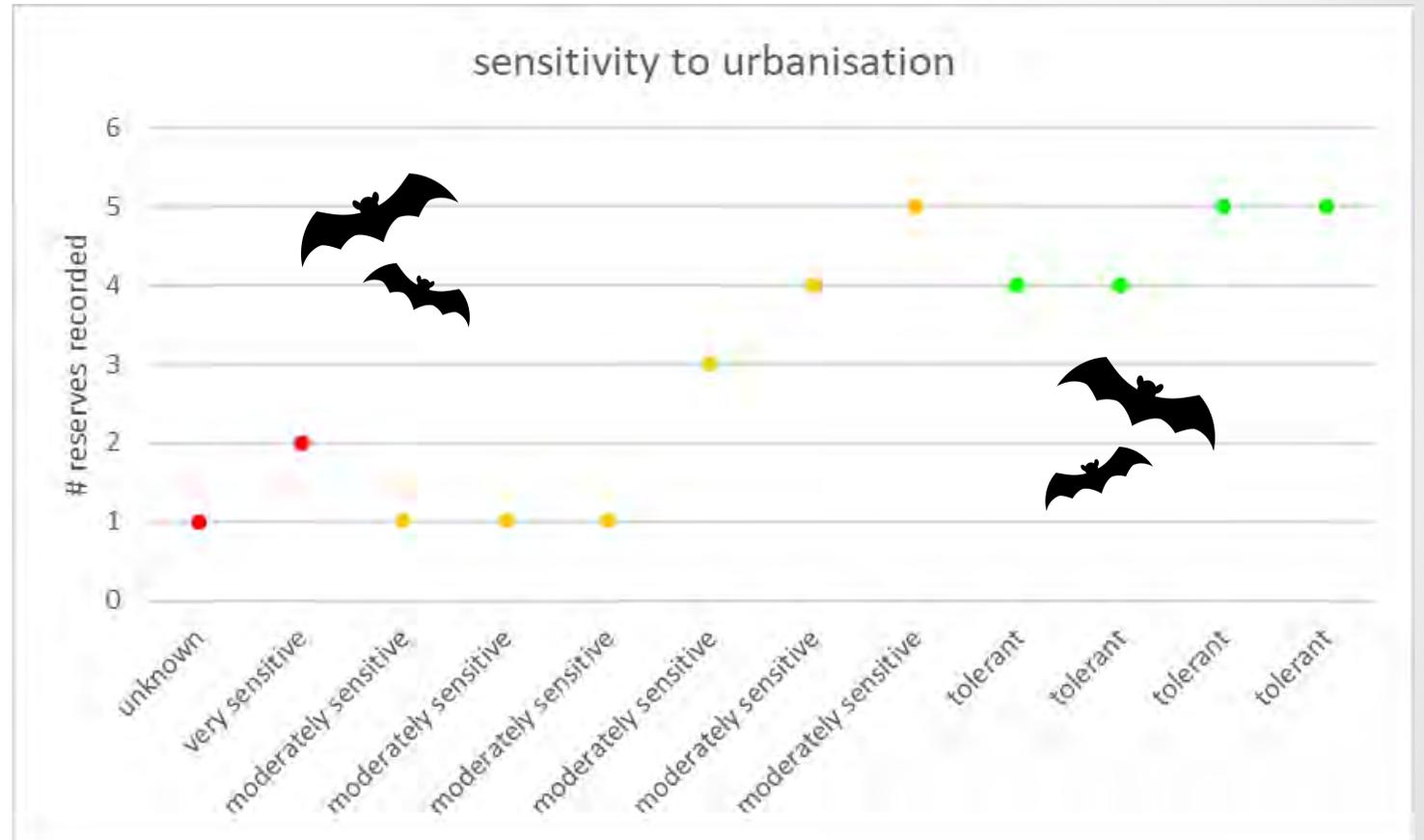
* Overall sensitivity to urbanisation is described in Threlfall et al (2012).

Echolocation ranges are based on Reinhold et al (2001) and Pennay et al (2004)

Recorded in FOM by ACA in 2016 only
recorded by PdD student in FOM in 2017

SENSITIVITY TO URBANISATION

- Used literature to find
 - Echolocation frequency
 - Flight patterns
 - Foraging niche
 - Sensitivity to urbanisation
- Compared this with the number of reserves/corridors present



WHO ARE THESE MICROBATS ANYWAY?

- **Eastern Bentwing Bat (*Miniopterus orianae oceanensis*):** Seasonal migrant, needs large reserves, vulnerable across its range
- **East-coast Free-tailed Bat (*Mormopterus norfolkensis*):** Open space feeder sensitive to urbanisation
- **Large-footed Myotis (*Myotis macropus*):** aka Fishing Bat, clutter tolerant and affected by water quality and artificial lighting
- **Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*):** Large, open space feeder over forests, seasonal migrant?
- **Little Forest Bat (*Vespadelus vulturnus*):** Tiny, clutter dependent feeders, obligate tree hollow dwellers





Eastern Bentwing Bat

- Seasonal migrant to overwintering cave, then maternity cave, then up to 300km back to coastal habitat
- Vulnerable to bushfire (loss of habitat and death of animals), pesticide use (loss of food resources, vegetation clearing (habitat loss, loss of directional marker trees)
- High flying, moderately manoeuvrable open space foragers
- Low frequency calls travel further but only locate larger prey
- Need large reserves for summer habitat
- Recorded in 4 reserve corridors in 2017

East-coast Free-tailed Bat

- Fast flying open space feeders with low manoeuvrability
- Maternity roosts in mangroves
- Frequent changes of roosts but high fidelity to an area
- Affected by artificial lighting especially during foraging
- Recorded by ACA in 2016, not recorded in 2017



Large-footed Myotis

- Medium fast flyer, moderately manoeuvrable
- Fly over creeks and rake their clawed hind feet through the water to catch fish and insects
- Affected by poor water quality and increasing urbanization
- vulnerable to heavy metal pollution and bioaccumulation
- Recorded in 2 reserve corridors in 2017



Yellow-bellied Sheath-tailed Bat

- Little known species, suspected seasonal migrant
- Largest microbat species in Sydney
- Open forager, fast flying but not very manoeuvrable –
- Avoids foraging in areas with artificial lighting
- Feeds over forests, roosts in tree hollows and old buildings
- Recorded in 4 reserve corridors in 2017



Little Forest Bat

- Clutter dependent, highly manoeuvrable flyer
- Feeds within the canopy of trees
- Smallest microbat species in Sydney
- Very high frequency calls don't travel far but locate small insects
- Hollow dependent for roosting locations, requires trees with hollows surrounded by dense vegetation/canopy
- Affected by increased artificial lighting, and by loss of habitat following bushfire (including HR burns)



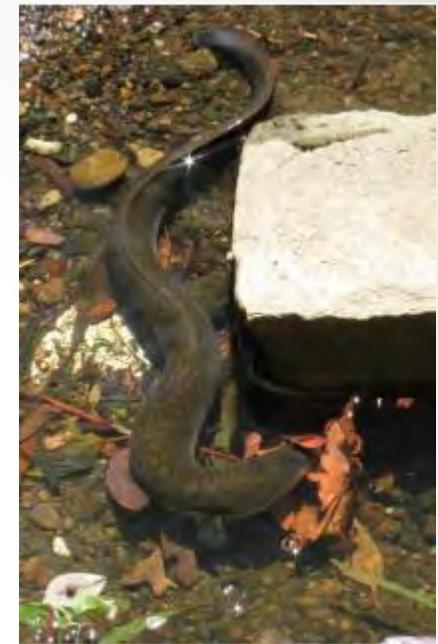
FISH SURVEY RESULTS 2017



The **Smallmouth Hardyhead** is a small silvery-coloured fish that is common in shallow coastal habitats of southern Australian waters.



The **Striped Gudgeon** is mostly found in slow-flowing, often muddy water streams where it feeds on *Gambusia* and aquatic insects

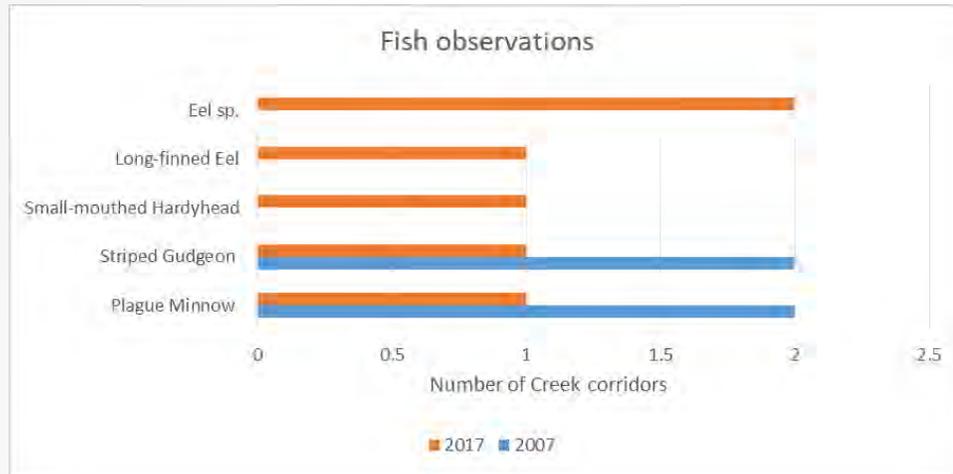


The **Short-finned Eel** migrates to the Coral Sea every year to spawn, before returning to live in southeastern Australian rivers, lakes and dams



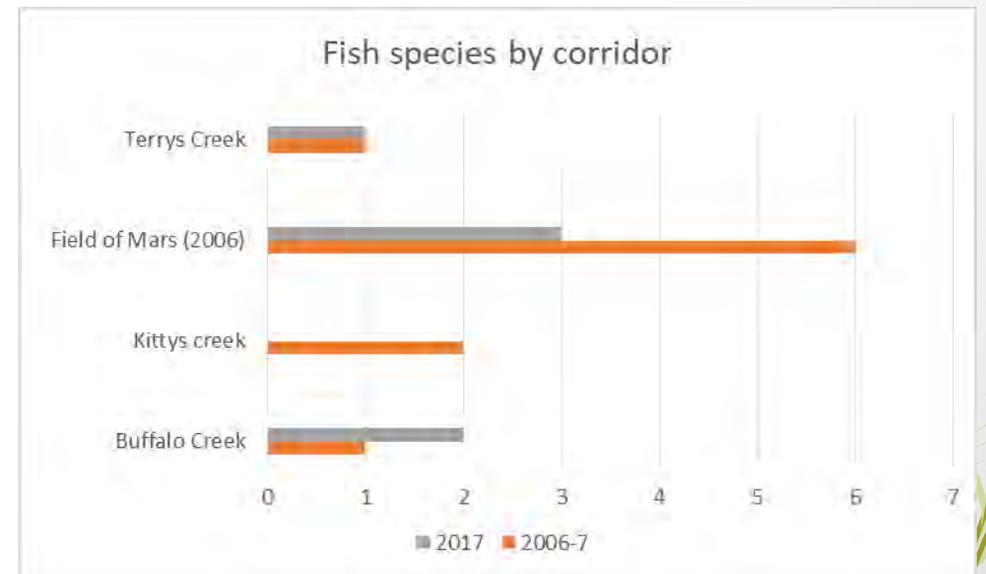
Female (large) and male (small) **Gambusia** (NSW DPI), a Class 3 noxious species in the Sydney basin

Comparison of 2007 with 2017



- Two species were reported in 2007, compared with four species in 2017
- Many species were only recorded in one, or occasionally two corridors

- Many of the species recorded in Field of Mars Reserve were estuarine – not surveyed 2017

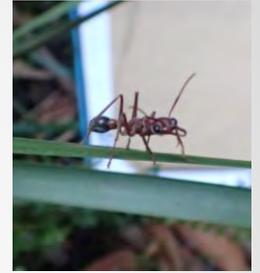
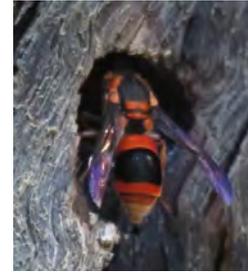


INVERTEBRATE FAUNA SURVEYS

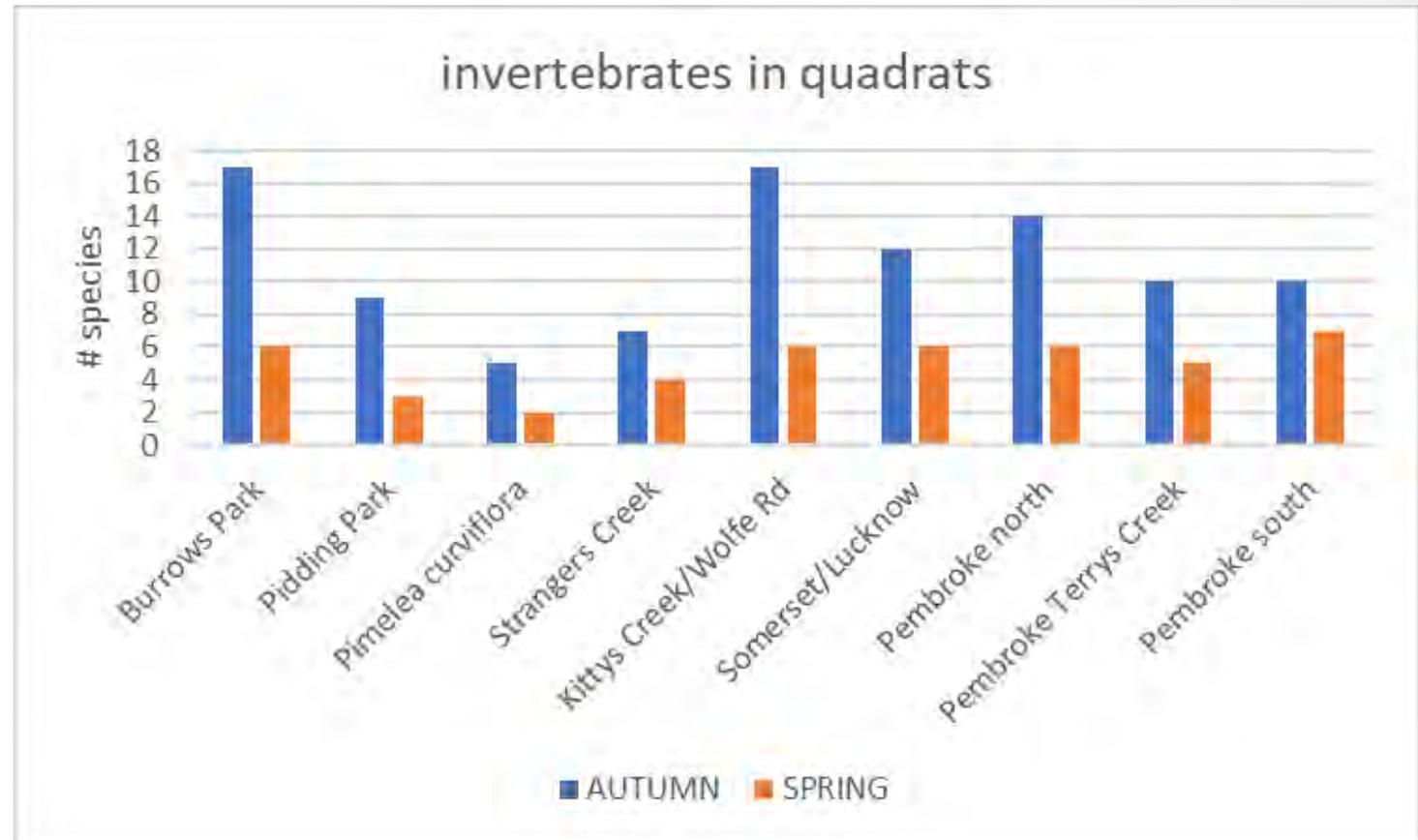
Autumn and Spring, 2017



INVERTEBRATES IN QUADRATS

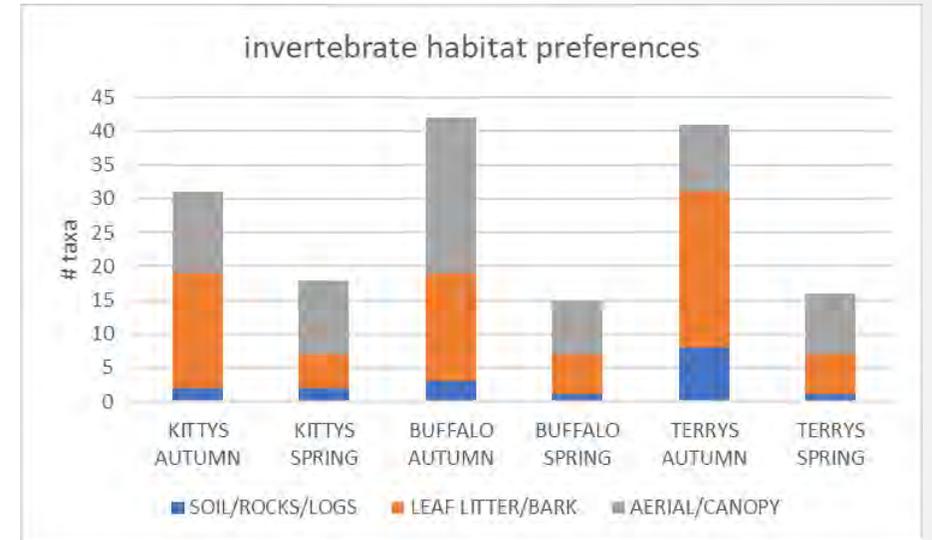


- Lower diversity and abundance in spring, probably due to dry weather
- Consistent across all quadrats



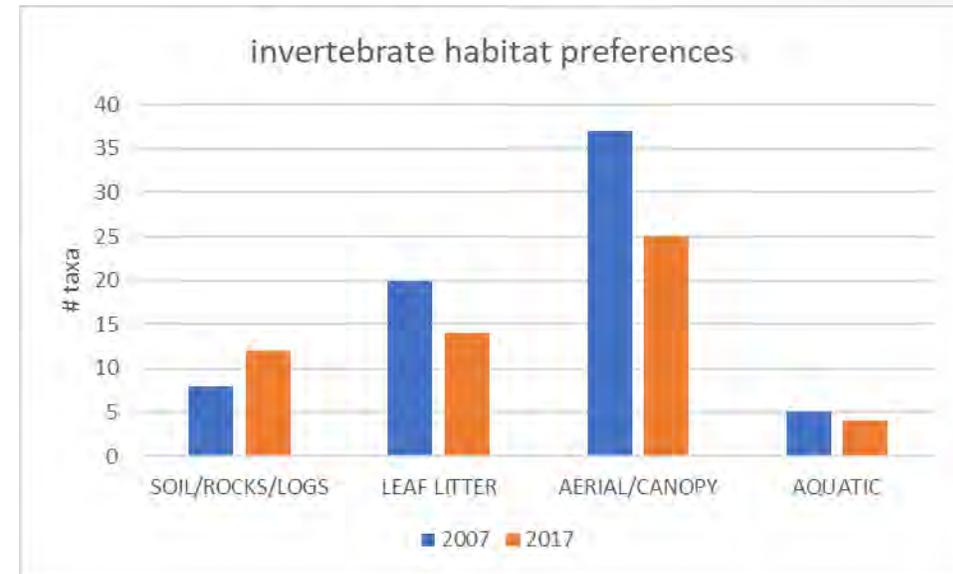
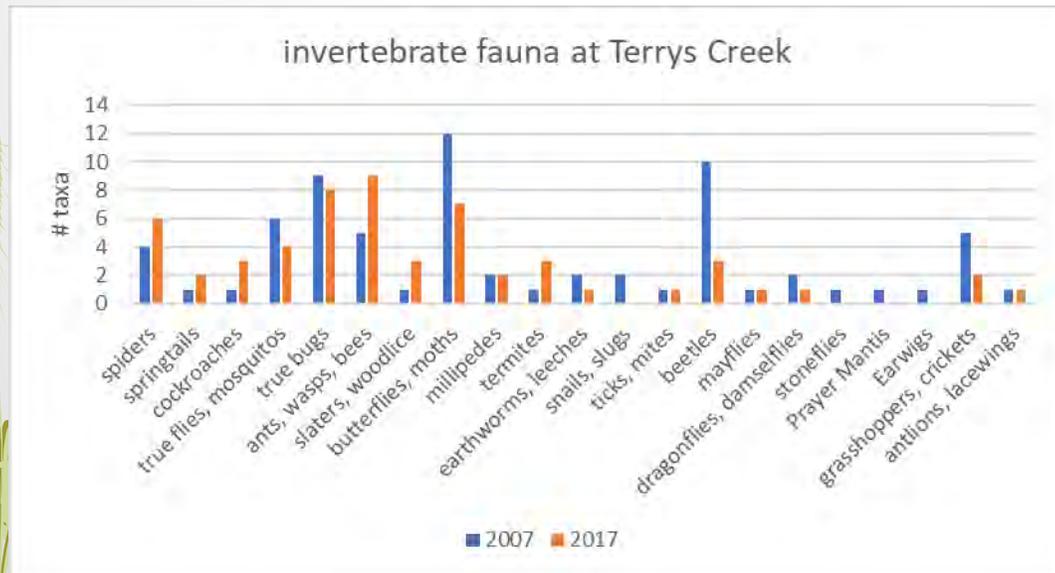
INVERTEBRATE HABITAT PREFERENCES

- Soil biota were mostly absent during the spring surveys
- Soil moisture linked with greater invertebrate diversity (Ives et al, 2007)



Terrys Creek corridor: 2007 to 2017

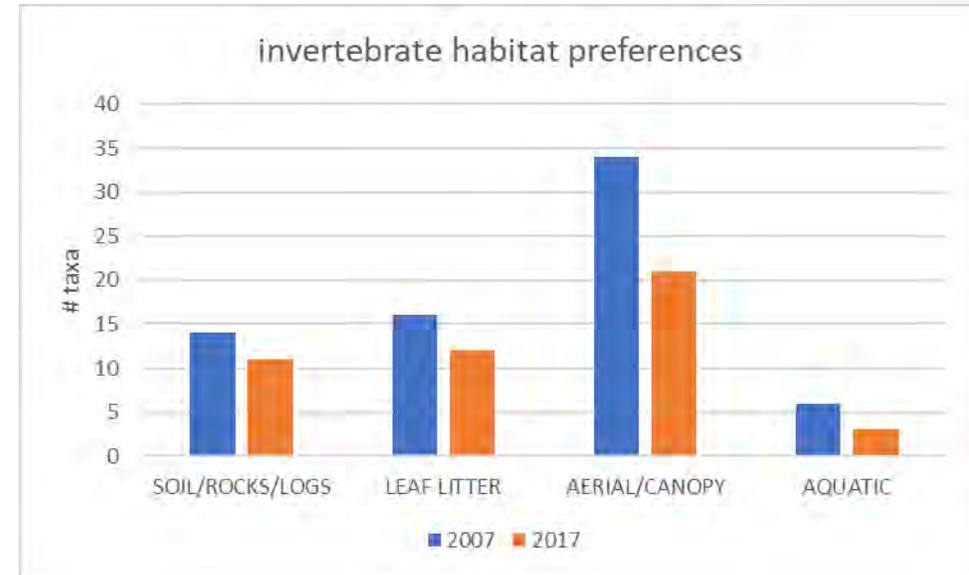
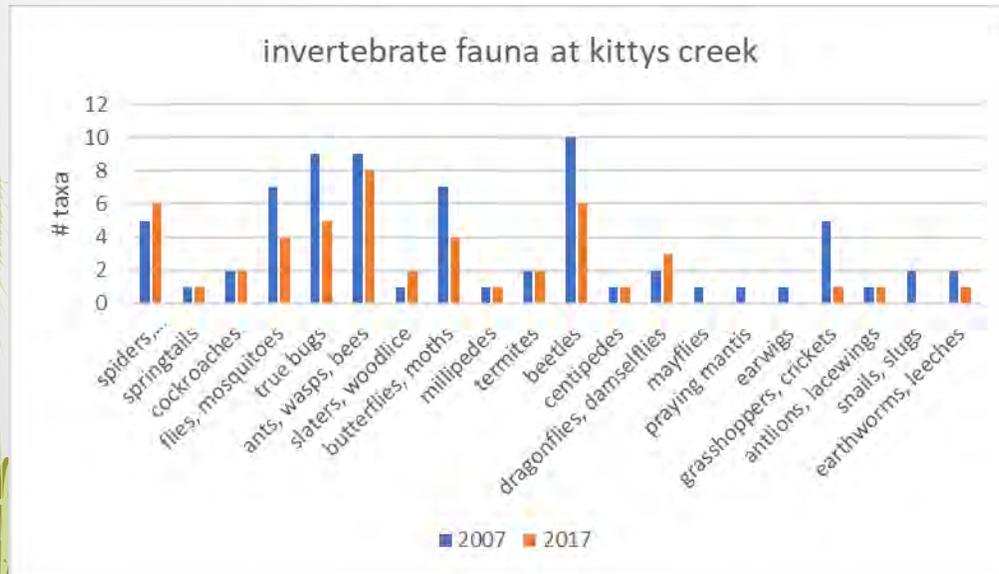
- 69 taxa reported in 2007
- 57 taxa recorded in 2017
- Missing taxa includes more sensitive groups



- Greatest diversity in canopy/flying
- Reduced number of taxa in 2017 except for soil biota
- Very hot summer in 2017?

Kittys Creek corridor: 2007 to 2017

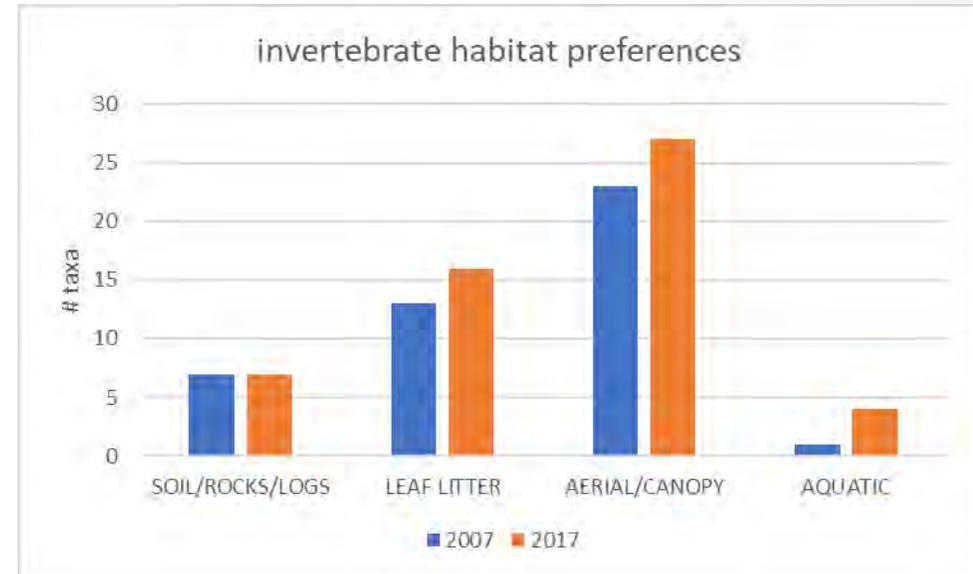
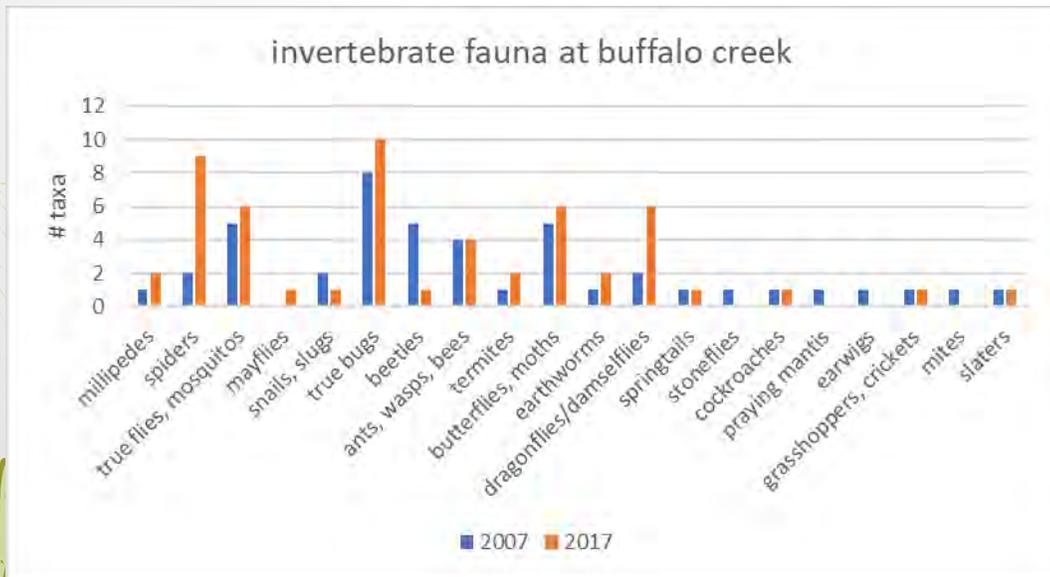
- 70 taxa reported in 2007
- 48 taxa recorded in 2017
- Missing taxa includes more sensitive groups



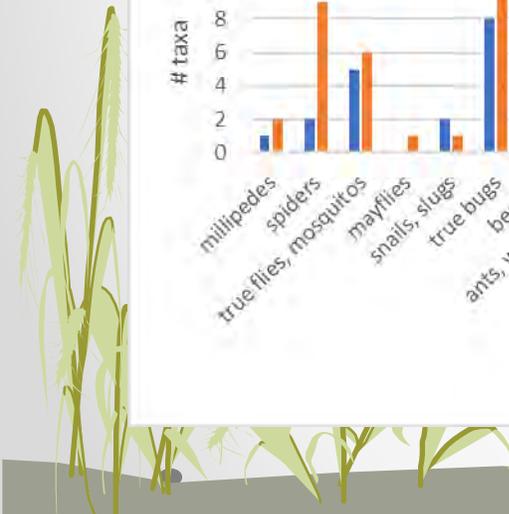
- Greatest diversity in canopy/flying
- Reduced number of taxa throughout in 2017...

Buffalo Creek corridor: 2007 to 2017

- 44 taxa reported in 2007
- 54 taxa recorded in 2017
- More taxa from common groups but fewer from sensitive groups

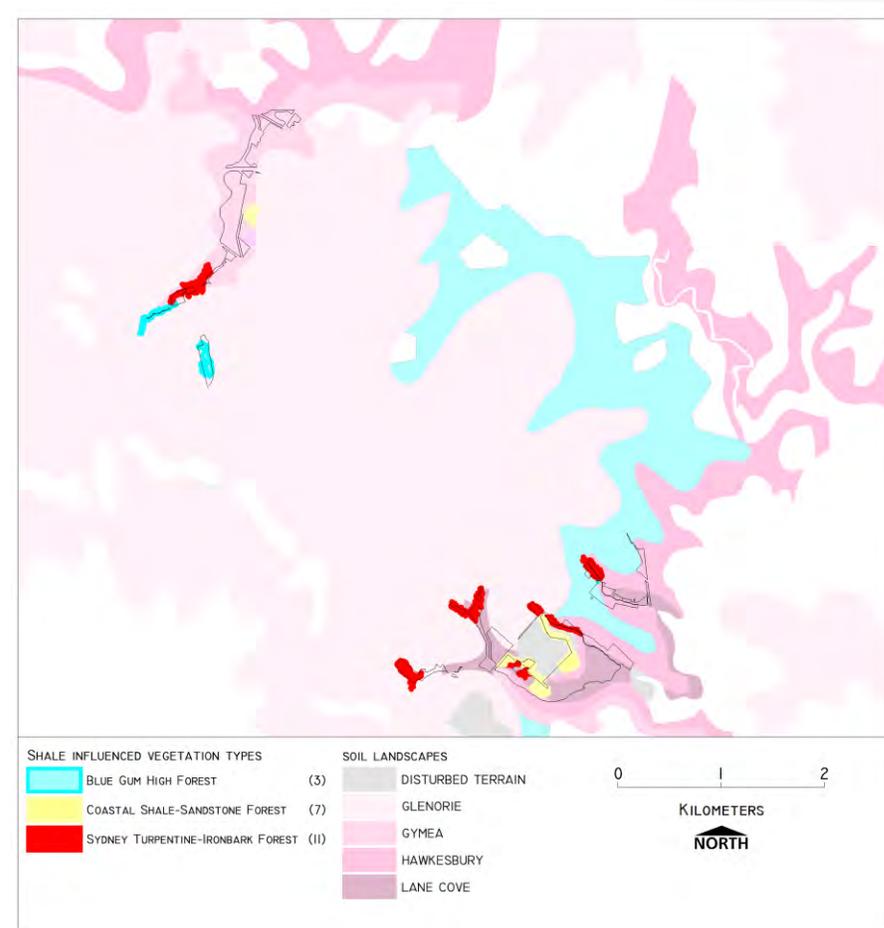


- Overall increase in taxa from each habitat niche in 2017
- But why?



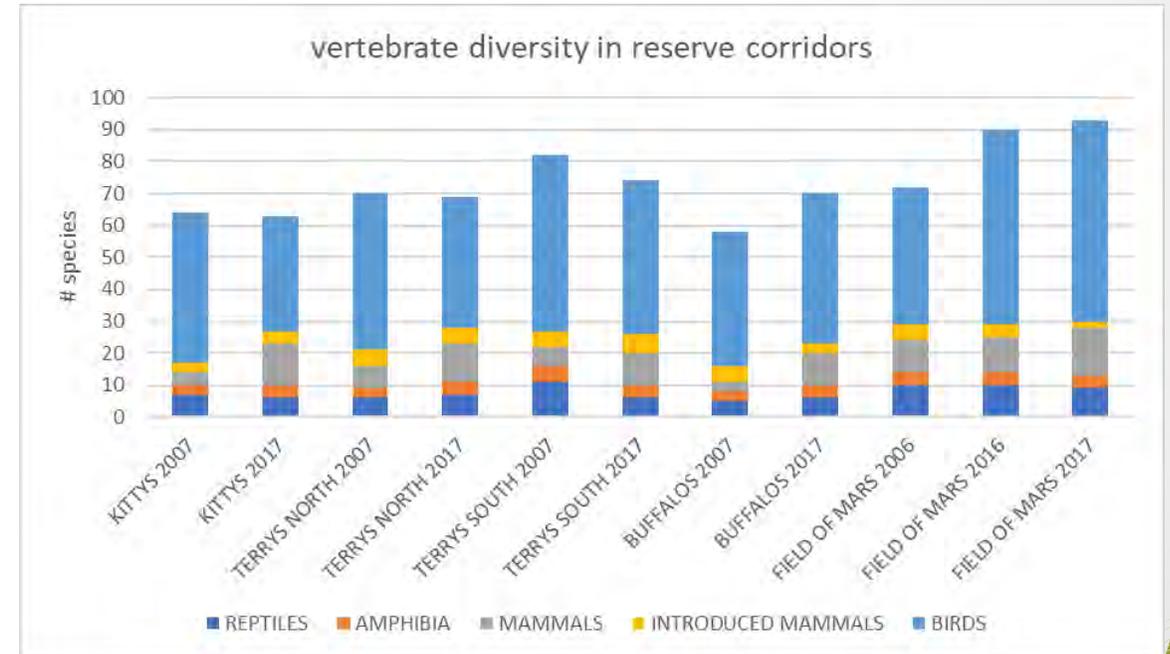
DURAL LAND SNAIL – TARGETED SEARCHES

- Very similar to Cumberland Land Snail but they do not co-occur
- Targeted searches undertaken in potentially suitable locations – based on soil landscapes and veg community types
- Dry weather did not favour finding them. Best time to search is at night, during/after wet weather in summer



TOTAL VERTEBRATE DIVERSITY

- Overall pretty similar 2007:2017
- More mammals in 2017
- Less birds in 2017



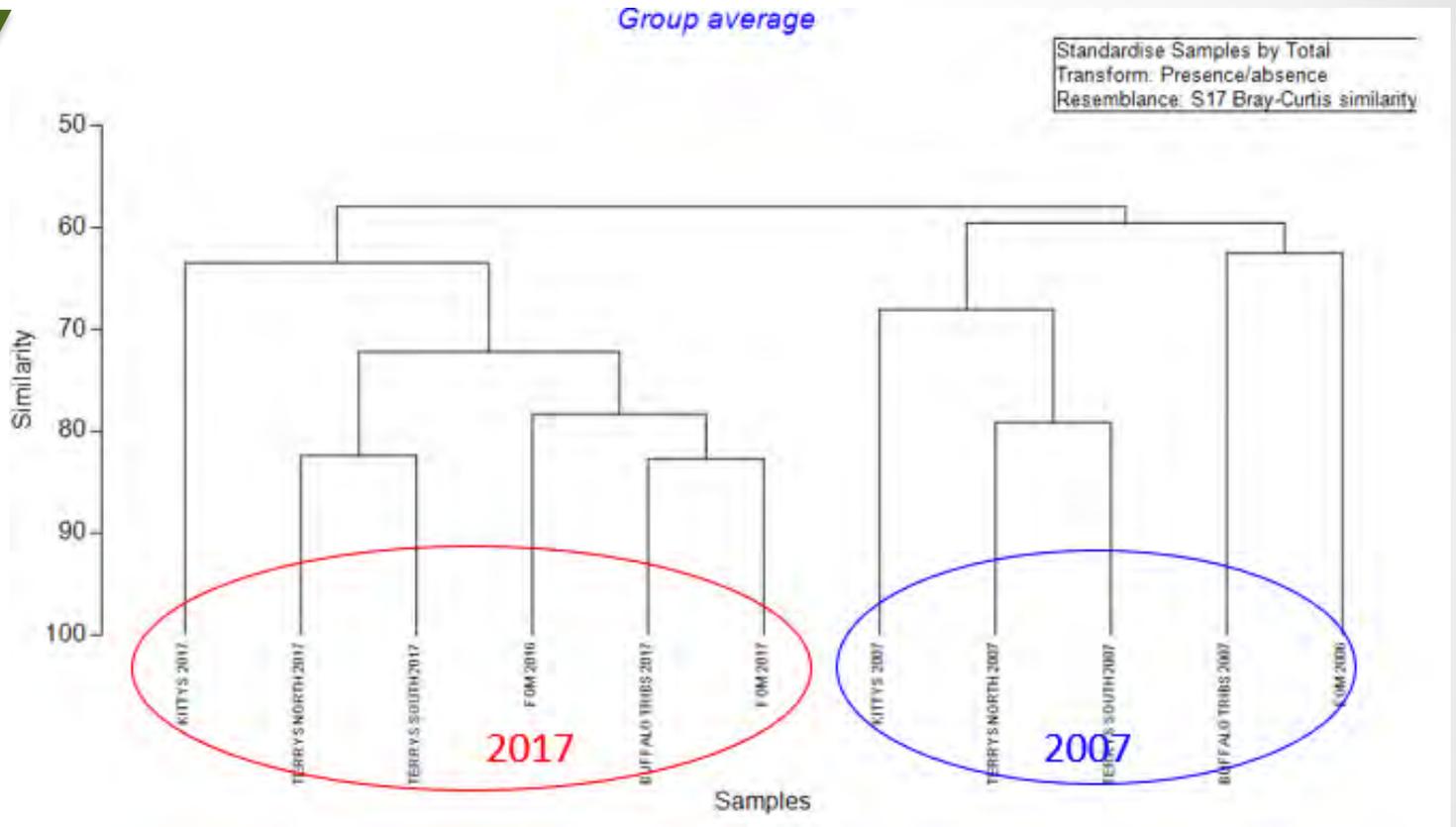
STATISTICAL ANALYSIS METHODS

- We used PRIMER-E MULTIVARIATE STATS FOR ECOLOGISTS v7 for analysis
- Firstly, we developed a similarity matrix of suites of species at each site for each season in 2017, and for results reported from 2007
- Used CLUSTER to produce dendrograms to show similarities between sites
- Used Non-metric Multi-Dimensional Scaling to produce nMDS plot to show relationships between sites
- Used Analysis of Similarity (ANOSIM) to quantify relationships – produces a global R statistic which shows how similar/dissimilar sites are based on suites of species present



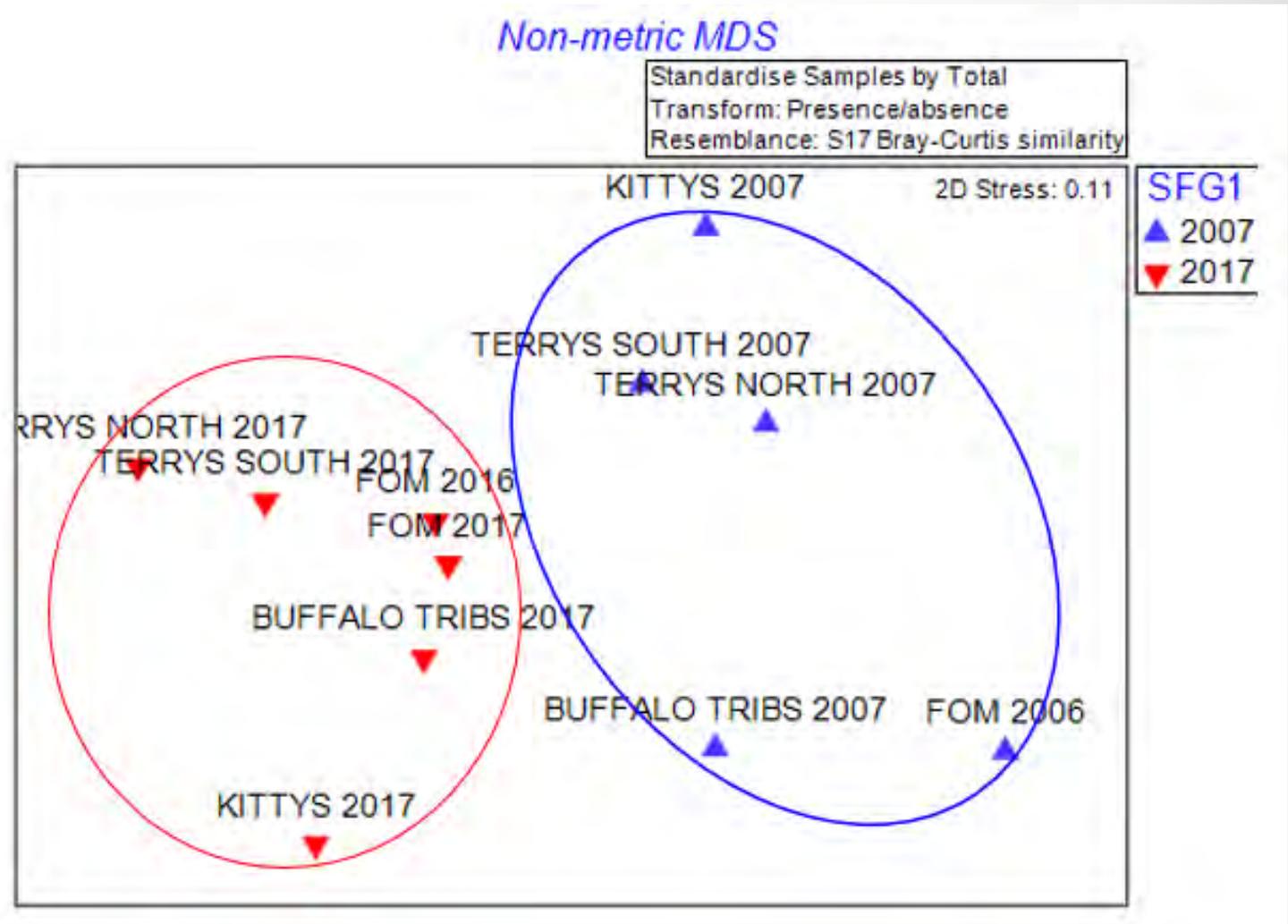
BIRD FAUNA 2007 VS 2017

- Grouped results into reserve corridors
- Found that all of the reserves surveyed in 2017 had bird fauna more similar to other reserves in that year than any surveyed in 2007



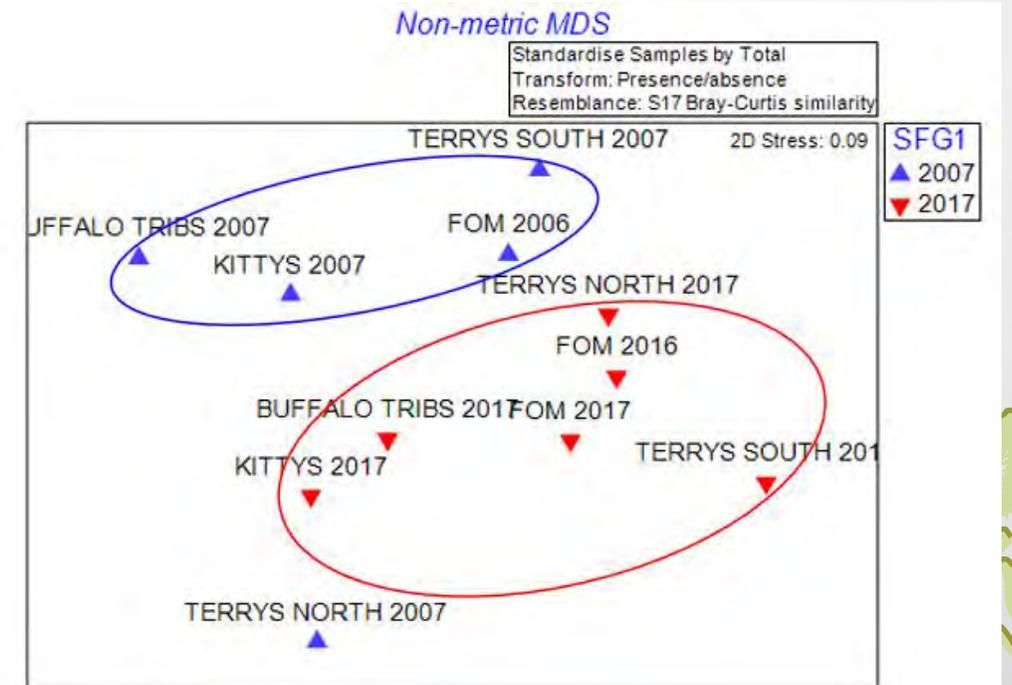
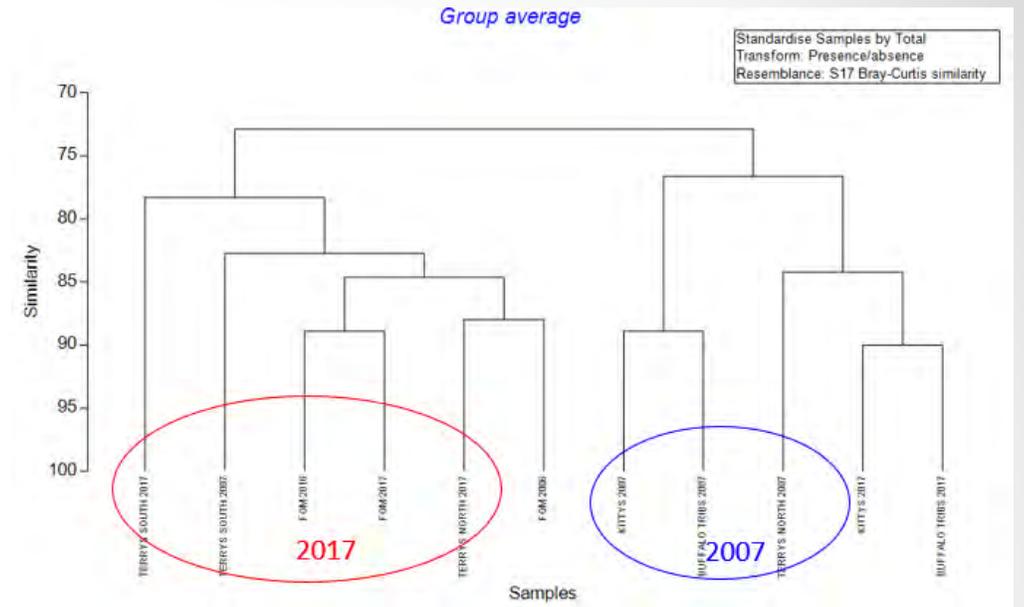
BIRD FAUNA 2007 VS 2017

- nMDS also showed an observable difference between suites of bird fauna for each year
- ANOSIM global R statistic = 0.0.643 ($p=0.002$) – shows that the difference is real and moderately large
- Causes? Possibly changes over time in bird fauna, also some partitioning of habitat between creek corridors



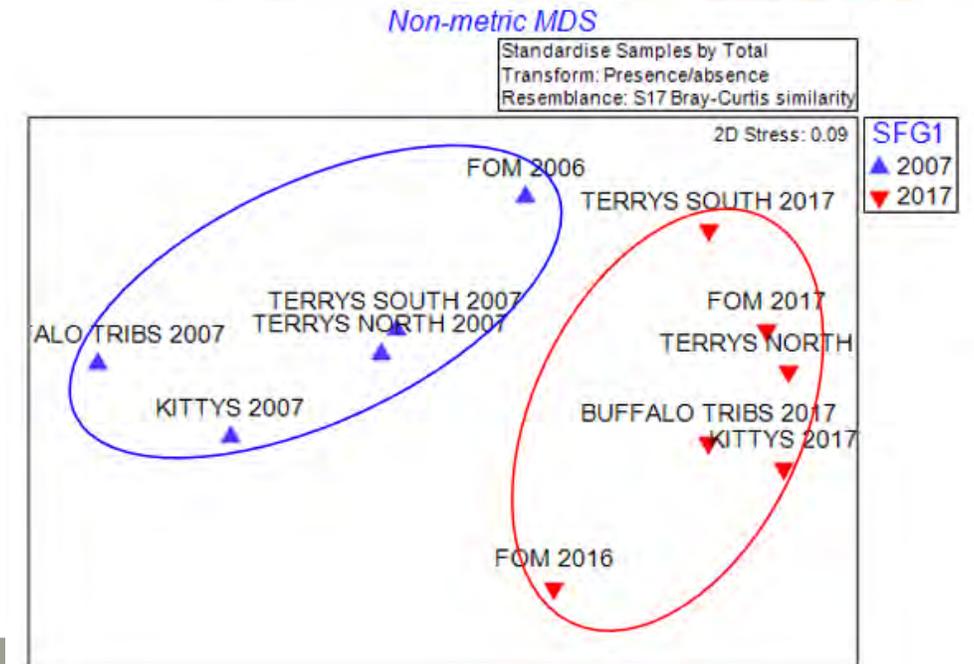
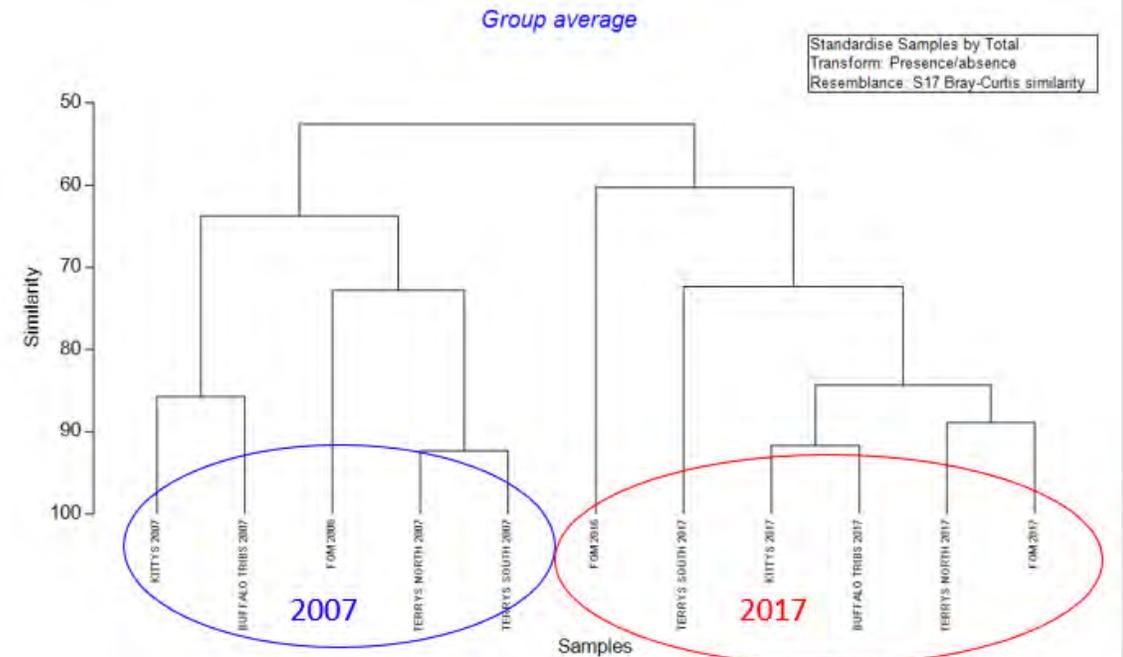
Reptiles & Frogs 2007 VS 2017

- Similar pattern of notable differences between 2007 and 2017
- Frogs and reptiles at different reserves were a bit different within each survey event
- Global R = 0.272 (p=0.041) indicates minor differences between the two surveys
- Interpretation: core group of frogs and reptiles present has not changed greatly over time



MAMMALIAN FAUNA 2007 VS 2017

- Results of mammal surveys were different for 2007 compared to 2017
- Global R = 0.813 (p=0.002) indicates a very large difference between suites of mammals in each survey
- Microbats!



SOME THINGS TO CONSIDER...

- Lots of apparent changes in species richness (numbers) and diversity (which ones) from 2007 to 2017
- In the ten years since 2007 there have been massive changes in technology – affordable remote cameras, weather resistant bat detectors
- Urban fauna species have often developed avoidance behaviours that mean they are rarely seen, but can be captured by non-invasive passive monitoring
- Random events – flood, fire, drought
 - Fire in FOM around 15 years ago... in recovery trajectory in 2007, but by 2017 it would be more stable... unless there is another stochastic event!
 - Extremely dry weather throughout Sydney in autumn, winter, spring, and into summer, leading to reduced invertebrates, reduced flowering and fruiting, and reduced numbers of birds and animals feeding on them
- Or is it increasing urban pressure on reserves and surrounding buffer areas?

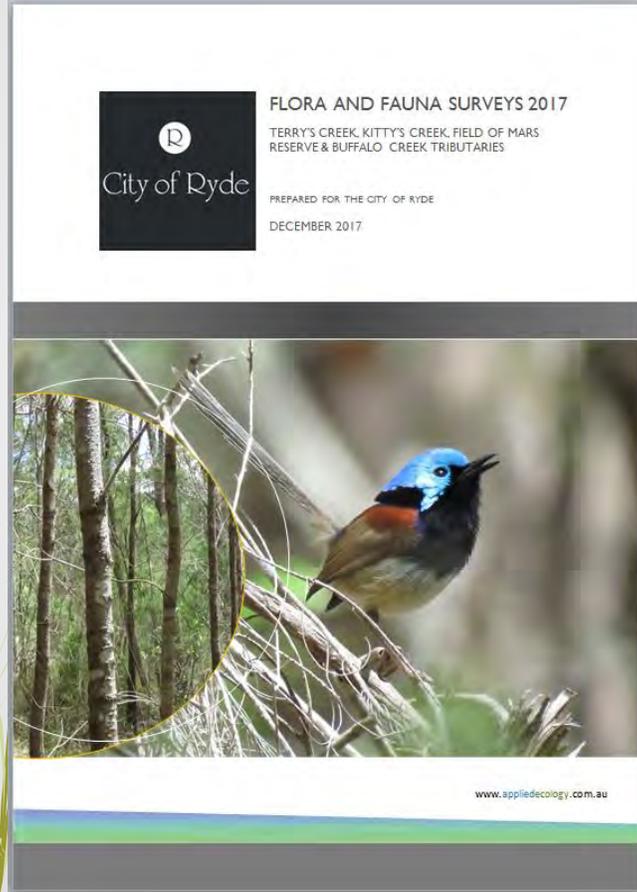




MANAGEMENT FOR FIRE IN RESERVES

- Whole of reserve burns are to be avoided at all cost
- Mosaic burns should burn less than half of any reserve, and there should be good dispersal of burnt and unburnt areas, ideally with a range of fire intensities for the burnt areas
- Native fauna species need to be able to move through the landscape to emigrate, access refuge areas, or remain in in-situ refuges, if they are to survive a fire
- Some species are not able to avoid fire, such as the Dural Land Snail, and some areas should be dedicated as 'fire excluded' for this and similar species
- A more holistic approach to fire management be adopted by council and any relevant fire authorities, such as NPWS, RFS, NSW Fire & Rescue

RECOMMENDATIONS



- Final report includes sections with management actions for specific faunal groups, including
 - Large ground dwelling birds
 - Hollow dependent birds
 - Small woodland birds
 - Water birds
 - Birds of prey
 - Nocturnal birds
 - Amphibians
 - Reptiles
 - Possums and gliders
 - Flying foxes
 - Swamp wallabies
 - Microbats
 - Dural land snail
- Also includes specific management recommendations for reserve corridors